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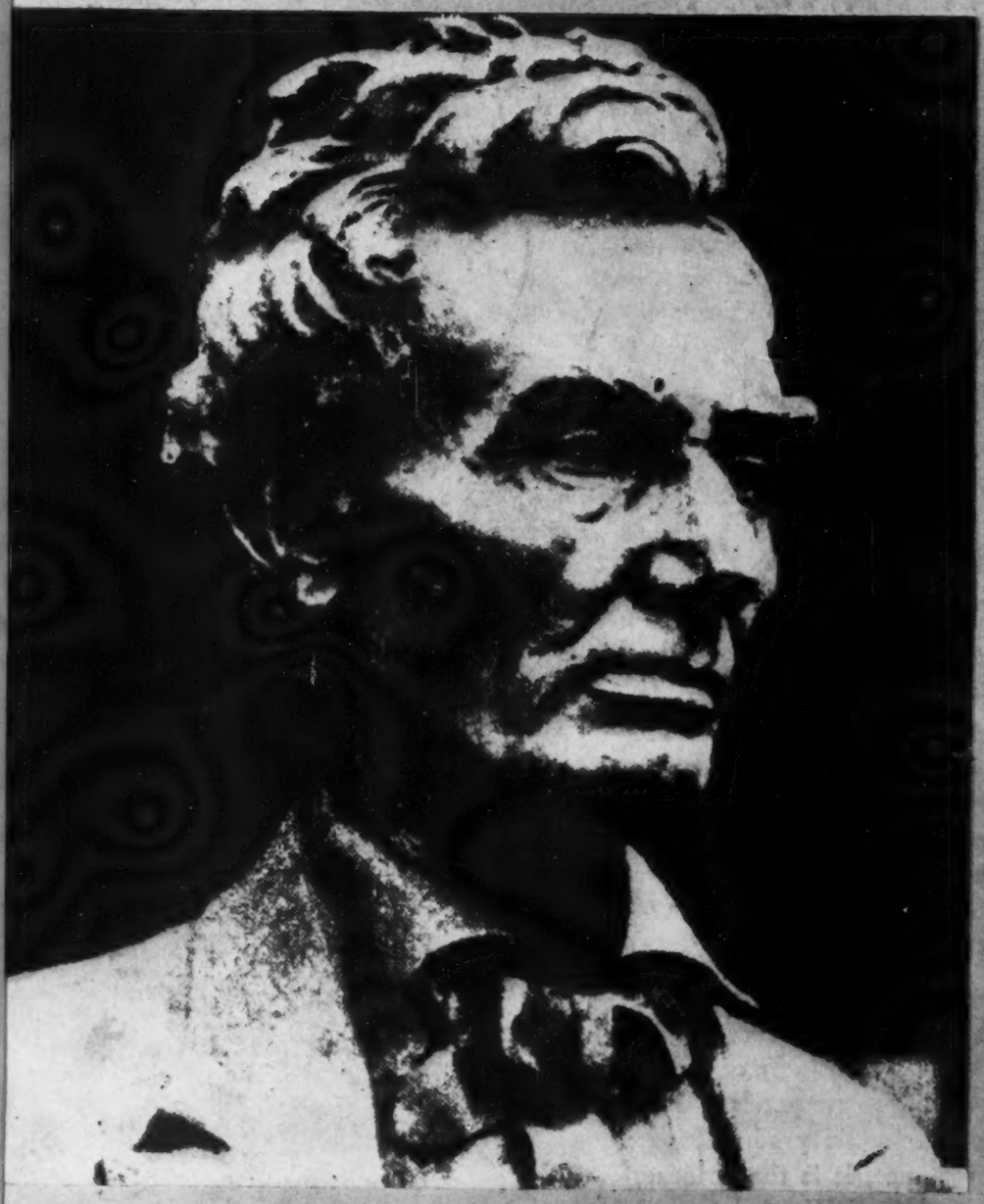
ELECTRICAL WORLD

For the week ending
FEBRUARY 8, 1930



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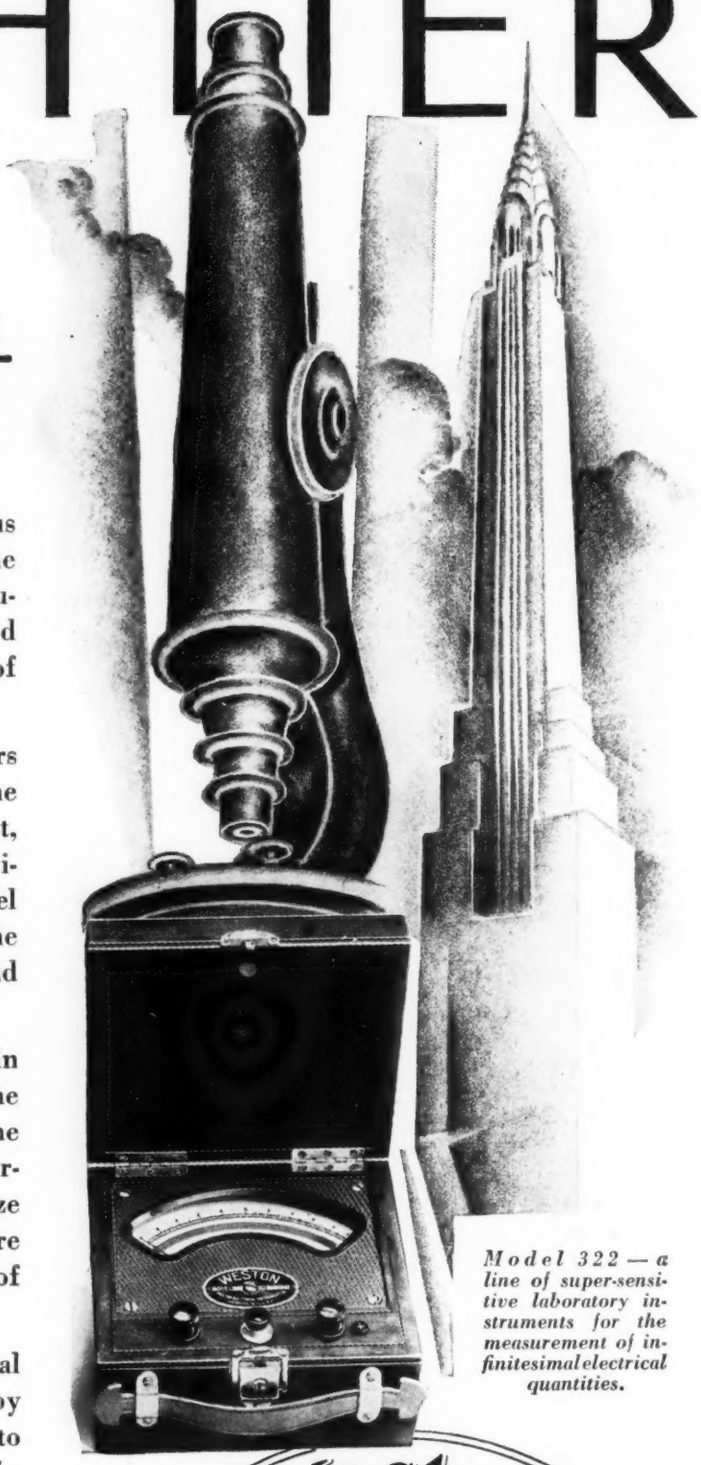

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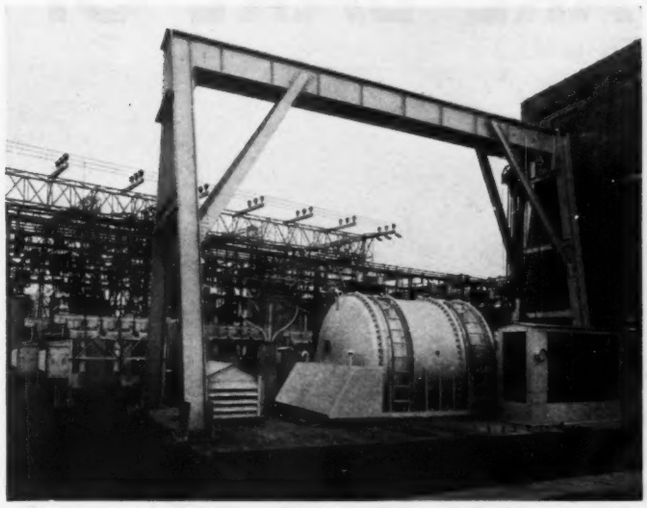

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ELECTRICAL WORLD

for the Week Ending

February 8, 1930

Comment On the News

COMPLETED PLANNING of the seventh and final "grid" in the English scheme of nation-wide interconnected power plants is a happy indication of transatlantic industrial progress. Transfusion — and diffusion — of electricity is the present-day remedy for anemic trade.

EXECUTIVE AND LEGISLATIVE interference, combined with politically influenced commissioners, is said to be the background for the resignation of Chairman Prendergast of the New York Public Service Commission. The cause of regulation loses a man of sound judgment and long experience and gains nothing.

HOW MUCH IS TEN CENTS a month to the average domestic telephone user? This is all he wins as a result of a valiant war of words waged before the New York Public Service Commission, spurred by the Governor to adjudication. Plainly the customer will not be grateful for so microscopic a boon. The telephone company's new charges may be perfectly just ones; but the situation seems to be that it has convinced vast numbers of persons that its service is a necessity to them without also convincing them that its methods of charging are fair and its charges to capital unassailable. Hence the strain on public relations so easily and eagerly magnified by the utility's critics.

TWO NEW ARRESTERS, a new circuit breaker and further knowledge of many engineering topics were the contributions of the winter convention of the American Institute of Electrical Engineers. The convention report in this issue and the article by C. E. Groesbeck indicate an unlimited field of opportunity for engineers.

THE LONG DEADLOCK between exponents of public and of private developments on the St. Lawrence is to be broken as the result of the recent semblance of political accord at Albany, Chairman Floyd L. Carlisle of the Niagara-Hudson Power Corporation thinks. The international aspect of the question does not deter C. A. Maguire of the Ontario Hydro-Electric Power Commission from equally rosy prophecy. If only optimistic expressions could build dams!

NEWS OF THE WEEK

Many Congressional Doings Have Much Bearing on Utility Projects

POSTPONEMENT until February 18 of the first hearing of the Federal Trade Commission's public utility investigation on the financial phase, previously set for February 4, has been announced. When it opens the financial structure of the American Gas & Electric Company will be probed. The principal subjects of inquiry will be capital structure and service contracts.

•

OPPOSITION to federal control of communications and power was voiced before the Senate interstate commerce committee by representatives of state public service commissions as the hearings on the communications phase of the inquiry closed this week. The principal arguments of this group were presented on Wednesday by John E. Benton of Washington, in his capacity as general solicitor of the National Association of Railroad and Utilities Commissioners.

"Never," Mr. Benton said, "has the federal government, either through the courts or through the commission, lowered an intrastate rate. When it acts, it acts to raise."

Mr. Benton and Senator Wheeler of Montana had a tilt over the purchase by the National Electric Light Association of copies of last year's report of the National Association of Railroad and Utilities Commissioners, which the Senator declared "reprehensible."

With the communications inquiry over, the committee will prepare its bill, which should be ready within the next few weeks, possibly early in March. Senator Couzens sprang a surprise when he announced that hearings on the power phase will begin on Monday, February 17.

•

SENATOR WAGNER on Wednesday presented to the Senate the memorial of the New York Legislature asking that Congress pass a law requiring utility companies which appeal from the decisions of public utility commissions to keep out of the federal courts until means of redress within the state have been exhausted. After a speech by the Senator, the memorial was referred to the judiciary committee, which has before it the Senator's own bill with this object in view.

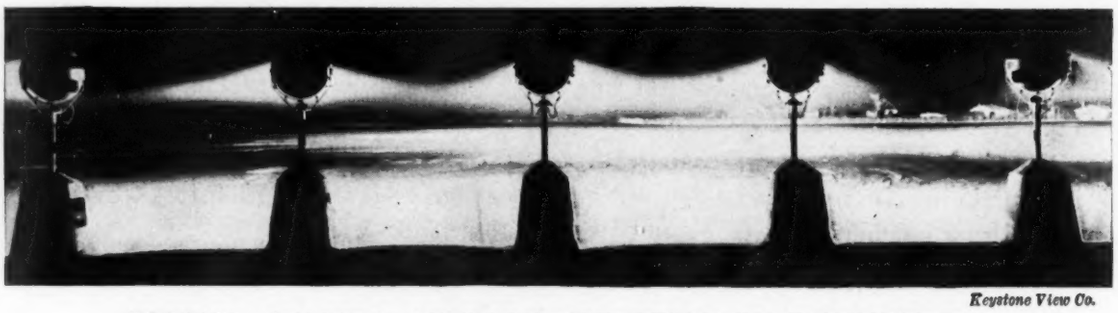
•

PROPOSALS for material increase in the personnel of the Federal Power Commission are before the House committee considering the independent offices appropriation bill. F. E. Bonner, the executive secretary of the commission; Colonel Max Tyler, its chief engineer, and Major Glen Edgerton, former chief engineer, took a positive stand against the proposal, which was urged by W. B. King, the commission's chief accountant, and Charles A. Russell, its solicitor.

Colonel Tyler said frankly that, in his opinion, "this whole fuss about the accounting has been made out of whole cloth for the purpose of building up a big organization. The law as enacted is an excellent one." Major Edgerton dwelt on the expense of the organization favored by Messrs. King and Russell. Mr. Bonner was sure that the Departments of War, the Interior and Agriculture can handle all the engineering and accounting problems assigned to them.

Mr. King, on the other hand, contended that the three governmental departments do not have personnel qualified to do the accounting and valuation work of the commission, especially in the case of the larger developments where the licensee is controlled by a holding company. Mr. Russell outlined his conception of an enlarged legal department, suggested the elimination of army engineers and the employment of a permanent chief engineer and complained that his official opinions were not acted upon by the staff of the commission. He said, as an instance, that the Niagara Falls Power Company had refused to produce its books and that he had not been permitted to institute an action to compel it to do so.

Discussing the anonymous memorandum which had wide newspaper circulation last summer as an alleged utility document, Secretary Bonner said



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FRESNO (CALIF.) AIRPORT LIGHTING IN PERSPECTIVE

Ample illumination is cast on one of the newest of the nation's aviation fields by a bank of Crouse-Hinds 3,000-watt landing-field lamps

that, so far as he had been able to determine, it was "nothing but a clumsy fake designed to intimidate the commission."

Apparently the committee was not impressed by the efforts to enlarge the commission, as no increase in its appropriations was allowed with the exception of $5,750 to take care of salary increases made necessary by the classification act.

•

MORE political discussion regarding the sale of Boulder Dam power was heard in the Senate on February 1 from Senators Johnson and Norris. As reported last week, the latter had assailed a recent opinion handed down by Solicitor E. C. Finney of the Interior Department on the ground that the rights of municipalities and other public units given preference in the Boulder Canyon act would be jeopardized by the proposal to allot portions of the developed energy to private companies. On Saturday Senator Johnson stated that he was gratified to learn that the opinion is not binding on the department.

Representative Swing of California, co-author of the Boulder Dam act, sent a letter to Secretary Wilbur also taking exception to Mr. Finney's ruling.

Secretary Wilbur pointed out to a representative of the ELECTRICAL WORLD that Mr. Finney's opinion, like any other, seeks to interpret provisions of the law. It was asked and delivered, he asserted, to indicate what the Secretary's powers are under the Boulder Canyon act, sections of which are a subject of controversy even among those who took part in its drafting. Other interpretations are available. Thus the matter is far from being decided.

•

POWER permits or licenses on the Columbia River between Grand Coulee Dam site and the Canadian border are held up by the adoption of the resolution introduced by Senator Dill and referred to last week.

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ALLEGED propaganda and lobbying concerning Muscle Shoals will in the near future, be delved into by the Senate lobby investigation committee, according to its chairman, Senator Caraway of Arkansas, who says that these investigations will include a scrutiny of some of the Southern power companies.

•

WITH only 24 votes cast against it, the Cramton bill providing for the George Washington memorial parkway, referred to last week on page 229, was passed January 30. It entails the purchase of a narrow strip of land on each side of the Potomac from Chain Bridge, at the District of Columbia line, to a point just above Great Falls, and the purchase of land on several creeks tributary to the Potomac. The Dempsey amendment permitting Congress to develop plans for the use of the river, should it see fit in the future to do so, was adopted.

THE NINETEENTH EDISON MEDALIST

President Harold D. Smith of the A.I.E.E. bestows the coveted Edison medal upon Prof. Charles F. Scott of Yale for his contributions to polyphase transmission

▼

Commission Saves Little to New York 'Phone Users

AS UPSHOT of the New York Public Service Commission's deliberations on the telephone situation in that state (explained last week on page 230), its members unanimously agreed to cut about $60,865,000 from the $133,000,000 added by the company to the United States courts valuation to cover plant and depreciation reserve expenditures for the period from July 1, 1928, to June 30, 1930. Using the rate base thus arrived at, the commission ordered a 20 per cent reduction in the new rates the company had announced.

Though a slash of $3,000,000 a year in the company's income will result if the commission's rates, which it made effective for a three-month period, are continued, the saving to customers is insignificant. For instance, the great mass of householders with private telephones in New York City will benefit to the extent of exactly 10 cents a month. Counsel for the telephone company declared the commission's rates confiscatory, and it was announced that an appeal either to the commission itself or to the courts would be taken.

Governor Roosevelt commented as follows on the commission's action:

"This entire case shows more clearly than any theoretical argument the necessity of immediate steps to deprive federal courts of power to interfere with the actions of state regulatory bodies and to restore original jurisdiction to the state courts. Furthermore, the case shows the necessity of a complete restudy of the relationship between the state and public service utility companies, which companies are in theory and in fact creatures of the state, operating under licenses known as charters granted to them by the state itself."

▼

Lower Basin Conferees Go from Reno to Phoenix

FOLLOWING an eleven-day session in Reno, Nev., the representatives of Arizona, California and Nevada who met to discuss the division of Colorado River water and power in connection with the Boulder Dam project adjourned on January 30 to reassemble in Phoenix, Ariz., as soon as the presence of certain engineers could be assured. W. J. Donovan, chairman of the conference and personal representative of President Hoover, issued the following statement:

"As the result of this conference every state has come to a better appreciation of the difficulties and problems confronting its neighbors. From this has come a more conciliatory attitude and a more helpful spirit of co-operation. There is a genuine desire on the part of every

one to meet fully the responsibilities which this task has imposed, and it is because of my knowledge of that fact that I believe there is really hope for an agreement."

▼

Prendergast Resigns from New York Commission

FOLLOWING a conference at Albany on Tuesday between Governor Roosevelt and William A. Prendergast, chairman of the New York Public Service Commission, the latter offered his resignation from that body and the former accepted it, mutual expressions of personal esteem accompanying the transaction. Friends of Mr. Prendergast denied that the recent telephone rate hearing, urged by the Governor, had anything to do with his resignation and declared he had had it in mind for some time.

Mr. Prendergast's own statement said: "Governor Roosevelt has certain ideas relative to the regulation of public utilities in this state, with which ideas I am not entirely in sympathy. Among other things, I do not feel that the Public Service Commission, which has quasi-judicial functions, should be influenced in the exercise of those functions by the Executive or any other state agency." The Governor, on his part, observed that on utility regulation Mr. Prendergast belongs to one school of thought and he to another.

Mr. Prendergast, a Republican, was made chairman of the commission in April, 1921, by Governor Miller. His course has been conservative, and he has been attacked as unduly friendly to the utilities. Politics has also been present to some degree in agitation over commission rulings and in the appointment of a legislative commission to investigate the state law governing the regulating body.

Mr. Prendergast was charged with "pro-corporation bias" in a letter forwarded to Governor Roosevelt on January 27 in which ten specifications in support of this accusation were made. These specifications, which concern gas and telephone rate decisions, the Consolidated Gas-Brooklyn Edison merger, coal surcharges of the New York City Edison companies, the accounting system "advocated by the National Electric Light Association," and several charges in connection with alleged profits of the Long Island Lighting Company, were put before the legislative commission.

The resignation of the chairman will take effect on February 28. Meanwhile hearings on telephone rates are to continue. Governor Roosevelt will, under the law, appoint the new chairman and also a successor to Commissioner Pooley, whose term of office has expired.

U. G. & E. HAS NEW HEADQUARTERS

This eighteen-story limestone building at Fourth and Main Streets, Cincinnati, replaces the former scattered offices of the Union Gas & Electric Company and adds an architectural ornament to the city.

▼

Senator Knight Gives Views on Regulation

CONDEMNING emphatically the practice of utility-company appeals from public service commission rate decisions directly to federal courts, and specifically "recent attempts of the New York Telephone Company to fix rates" without commission approval, Senator John Knight, chairman of the legislative commission which recently inquired into the laws governing regulation in New York, said in a public address at Rochester on Wednesday of this week:

One is bound to raise a serious question concerning the feasibility of successful regulation if the leaders of the utility industry believe it in their interest to evade or avoid regulation by one means or another. Consistent evasion of regulation on the part of the utility companies is the best possible means of convincing the people of the country that regulation cannot succeed. I am not an advocate of public ownership, but the only alternative to utility regulation is public ownership. It seems to me that it behooves both the public and those in control of public utilities to make regulation successful.

▼

Submetering Upheld by Columbia District Judge

THAT the Potomac Electric Power Company of Washington has no legal ground for refusing electricity to apartment-house owners who submeter and resell energy to tenants was the opinion expressed by Justice Stafford of the District of Columbia Supreme Court last week. He therefore overruled a motion of the power company to dismiss the suit of four apartment-house owners brought to test the legality of the company's contract forbidding the submetering of its electricity.

As arguments had not yet been heard on the suit of the apartment-house owners, the decision of Justice Stafford represents only a partial victory for them. The company has been granted fifteen days in which to file an answer.

On November 15 last the Supreme Court of New Jersey sustained the Public Service Electric & Gas Company in making a rule similar to that of the Potomac Electric Company. (See ELECTRICAL WORLD, November 23, 1929, page 1051.)

▼

Final British Grid Scheme Drawn Up

WITH the publication of the seventh regional scheme for electrical development in the United Kingdom, the Electricity Commissioners have completed their theoretical network of power supply. The plans issued cover 94 per cent of the area of England and Wales and 98 per cent of the population.

This latest and final scheme covers southwest England and south Wales, an area of 17,234 square miles. It includes the counties of Hereford, Monmouth, Somerset, Devon, Cornwall, Dorset, Wiltshire and Southampton, parts of the counties of Berkshire, Gloucester, Oxford and West Sussex, the Isle of Wight and south Wales in its entirety. The area at the last census had a population of 6,085,000. It embraces densely populated industrial centers.

The cost to the Central Electricity Board of erecting the transmission system is estimated at nearly $17,000,000. In addition, there will be expended by existing electrical undertakings nearly $10,000,000 on extensions of stations. The main transmission system will comprise 623 route miles and 25 substations.

Americans Help Form European Holding Company Embracing Seven Nations

AN INTERNATIONAL public utility holding and management company which will operate primarily in the European field has been organized by prominent American and European interests under the laws of Canada. The new company will be known as the European Electric Corporation, Ltd., and its activities will be conducted under the leadership of Count Giuseppe Volpi di Misurata, formerly Italian Minister of Finance, who in that capacity negotiated the settlement of the debt of the Italian government to the United States.

Included on the board of directors of the new company will be Dr. Barth, managing director of the Bank for Electric Enterprises in Zurich, Switzerland, one of the largest electrical trusts in Europe, and representatives of the International General Electric Company and of the American & Foreign Power Company.

The European Electric Corporation, Ltd., will be interested either directly or indirectly in public utility enterprises in Germany, France, Italy, Austria, Spain, Poland and Greece. Its charter, which has been patterned after that of the Electric Bond & Share Company in the United States, empowers it to act in a supervisory capacity for electric power and light and other public utility companies and to supply technical engineering and financial assistance in connection with the financing, the business development and the operation of the companies and the construction of their properties. In addition, it has broad investment powers.

The indicated market value of the stocks of European utilities which the corporation is to acquire was in excess of $26,000,000 on February 1. The corporation will commence operations with more than $10,000,000 additional in cash. New financing, aggregating approximately $12,900,000, is expected to be undertaken shortly by the banking group sponsoring the new corporation, including Bonbright & Company, and Field, Glore & Company.

American shareholders in the new company are represented by Floyd B. Odlum, vice-president of the Electric Bond & Share Company and vice-chairman of the American & Foreign Power Company; C. H. Minor, president of the International General Electric Company; Niel A. Weathers, chairman United Electric Securities Company (General Electric Company's securities affiliate), and Giovanni Fummi, director of Fiat and of the Pirelli Company of Italy. Bonbright & Company, Inc., and Field, Glore & Company will also be represented on the board.

▼

Carlisle Sees End of St. Lawrence Deadlock

TESTIMONY given by Floyd L. Carlisle, chairman of the executive board of the Niagara-Hudson Power Corporation, before the Water Power and Control Commission of New York last week, at a hearing on a proposal to increase the annual horsepower rental for water diverted for power purposes on the Niagara River from 65 cents to $5, gave color to the idea that the corporation he represents, the most important in the power field in New York State, will do nothing to obstruct Governor Roosevelt's proposal for power development on the St. Lawrence under state auspices. Mr. Carlisle said the projected development would place the state in the forefront of cheap power producers and bring vast expansion in its industries.

On the other hand, Mr. Carlisle testified that the state's desire to increase water rental on the Niagara River to $5 would have a tendency to drive industries to the South or the Pacific Coast, where water power is cheaper.

"There is definitely in sight an end of the deadlock over water-power development on the St. Lawrence," Mr. Carlisle observed. "We favor it."

▼

Ontario Hydro Man Optimistic Over St. Lawrence

NOTWITHSTANDING many statements to the effect that the Province of Ontario is losing its interest in the hydro-electric development of the international section of the St. Lawrence River and is likely to be content with other and all-Canadian sources of power, importing it from Quebec, building 210-kv. transmission lines like the one now in operation from the Gatineau and the additional one contemplated, and generally exploiting home resources to the utmost, C. Alfred Maguire, a prominent member of the Hydro-Electric Power Commission, has just expressed himself as being very hopeful that a start will be made on the St. Lawrence River project in the near future.

Mr. Maguire's statement was made at the annual meeting of the Ontario Municipal Electric Association, of which he was re-elected president.

HOW FEED WATER REACHES GERMAN PLANT

A recently completed generating station serving Dresden, said to be the second largest in Germany, gets its feed water from the River Elbe by means of tubes running uphill and down.

BEAUHARNOIS AND THE ST. LAWRENCE

This sketch map shows the relationship between the great hydro project of the Beauharnois Light, Heat & Power Company of Quebec and the St. Lawrence River as a whole. It shows also the relationship between Beauharnois and the existing power producers on the river, which utilize only a portion of the full head available between Lake St. Francis and Lake St. Louis

Indiana Merger Hearing Set for February 24

HEARINGS on the proposed "seventy-million-dollar" Insull utility merger in Indiana, involving electric, gas and traction interests affecting more than 250 cities, will probably be resumed February 24, this being the tentative date set by the Indiana Public Service Commission. No hearings will be conducted unless all the commissioners attend.

The first part of the hearing was concluded in December. Commission auditors have since been checking the valuation figures of engineers for both the commission and the utilities concerned. A difference of approximately $7,000,000 exists between the two appraisals, the higher one having naturally been made by the utility engineers.

▼

More Interconnection in the Pacific Northwest

EIGHTY miles of 110-kv. transmission line beetween White Salmon and Yakima, Wash., to constitute the first link in an interconnection of the systems of the Washington Water Power Company, Spokane, and the Northwestern Electric Company, Portland, will be built in 1930, according to an announcement by Guy W. Talbot, president of the Northwestern Electric Company and the Pacific Power & Light Company. This transmission line, which is to cost $1,100,000, will connect the Condit plant of the Northwestern Electric Company with the Yakima-Walla Walla system of the Pacific Power & Light Company. Other connecting links for construction subsequently will be a 110-kv. line between White Salmon and Vancouver, Wash., to be built after the new Ariel plant of the Northwestern company on the Lewis River is placed in operation, and a short piece of 110-kv. line between Yakima and Taunton, Wash., where the Washington Water Power system is now tied in with the Pacific system.

Survey for the coming 64-mile, 110-kv. transmission line of the Washington Water Power Company from Spokane, Wash., to Kellogg, Idaho, is rapidly being carried on. It will be the second 110-kv. line built from Spokane to the Coeur d'Alene mining district.

Work has started on a 48-mile, 110-kv. steel tower transmission line from the San Joaquin Light & Power Corporation's Ashlan substation near Fresno, Calif., to its Wilson substation near Merced. The line will cost approximately $720,000. It will be insulated for 220 kv. and will be of double-circuit construction, although only one circuit is being built at the present time. Completion of this line will make an unbroken transmission line 228 miles long from the Great Western Power Company's Buck's Creek power house, east of Oroville, to Fresno, on the San Joaquin system. At present power used by the San Joaquin company from its tie line with the Great Western company must enter the southern system over a line running back into the mountains by way of the San Joaquin's Kerckhoff power house.

▼

Quebec Visions $500,000 Revenue from Beauharnois

EXTENDED powers for the Beauharnois Light, Heat & Power Company in the matter of expropriation of lands necessary for building its canal from Lake St. Francis to Lake St. Louis on the St. Lawrence River are provided for in a measure before the Quebec Legislature. Under the statute passed in 1928 the company was empowered to expropriate such lands as might be necessary, not exceeding in all 6 arpents (about 400 ft.) in width. This is changed in the present bill to 21 arpents in width. The present plans of the company call for a development of 500,000 hp. It has been made no secret, however, that the ultimate hope of the company is to develop 2,000,000 hp.

It is understood that the Quebec government's revenue from the Beauharnois hydro-electric development will be $1 per horsepower.

The province has now an annual revenue of 30 cents per horsepower as its share of the proceeds from power production at Cedars Rapids on the St Lawrence.

▼

Philadelphia Electric Pushing 220-Kv. System

SYSTEM increases to be made by the Philadelphia Electric Company this year include the installation of an additional transformer bank at Plymouth Meeting substation connecting the 220-kv. and 66-kv. buses, a 220-kv. line from Plymouth Meeting to the Roseland substation of the Public Service Electric & Gas Company of New Jersey and an additional 66-kv. line between Plymouth Meeting and Westmoreland substations. The rating of the Plymouth Meeting bank will correspond to that of the present banks, namely 130,000 kva. with forced air cooling. Westinghouse equipment will be used.

Orders have also been placed with the Westinghouse company for two high-speed oil circuit breakers for 220-kv. service at Plymouth Meeting and with the General Electric Company for a similar number of units. These

breakers will have an interrupting rating of 2,500,000 kva. Nine Westinghouse and General Electric breakers for 66-kv. service will be rated at 2,000,000 kva. interrupting capacity.

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Municipal Competition Held Path to Low Rates

LEGISLATIVE authorization of municipal ownership and permission to municipalities to serve the surrounding territory without constant recourse to the lawmakers and to replace private plants at the end of the franchise period without obligation to purchase obsolete facilities; authorization of power districts wherein municipalities may interconnect to use state-developed water power, and authorization of the development by connected municipalities or by the state of the water-power resources of the state—these are the five recommendations made by Prof. H. S. Raushenbush of Dartmouth College to the legislative commission on the revision of the New York public service law as suitable matter for incorporation in the commission's own coming recommendations to the Governor and Legislature of that state.

Professor Raushenbush, who is a member of the executive committee of the Committee on Coal and Power, a group of New York citizens of radical tendencies, expresses the view that public service commissions can do little to lower rates and that municipal competition both in generation and transmission will help achieve that end. In his opinion the situation on the Pacific Coast sustains his contentions.

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Middle West Men Not Impressed by Power Plan

DELEGATES representing the governors of eight Middle West states interested in a combined flood-control and irrigation project to be urged upon the federal government in connection with its flood relief program have definitely ignored Senator Norris' recommendation that the scheme also include the utilization of power from the reservoirs. Delegates to the conference said that power development could only be incidental, and being in portions of states remote from the principal markets for electrical energy, they held it to be unimportant. They added that its inclusion would endanger the success of the project because of the opposition to public ownership.

Plan Science Exhibits for Chicago 1933 Fair

FORMULATION by the National Research Council's science advisory committee of a general plan for the World's Fair to be held in Chicago in 1933 is going on rapidly. This fair, which will celebrate the hundredth anniversary of the settlement of Chicago, is to commemorate also "a century of progress," with "the contributions of pure and applied science to industrial development during the last hundred years as the main theme."

R. F. Schuchardt

Rufus C. Dawes, president of the board of trustees of the exposition, urged the National Research Council, of which Dr. George K. Burgess is chairman, to extend its advice and assistance. The council consented to do so and has already drawn up a "conception of the plan of exhibits," containing two main divisions—(1) fundamental sciences and (2) applications. The fundamental sciences, eight in number, are mathematics, physics, chemistry, biology, geology, anthropology, psychology and astronomy. The applications, 26 in all, to which others may be added, include electrical engineering, electrochemistry, illuminating engineering, mechanical engineering, steel treating and roentgenology. There is planned to be a central hall devoted to the fundamental sciences surrounded by exhibition halls showing their application.

R. F. Schuchardt of the Commonwealth Edison Company is chairman of the subcommittee on electrical engineering of the National Research Council's science advisory committee. This subcommittee is itself divided into three parts—one on generation, one on distribution and the third on utilization Of these H. W. Fuller, Byllesby Engineering & Management Corporation; E. C. Stone, Duquesne Light Company, and J. F. Gilchrist, Commonwealth Edison Company, are respectively chairmen.

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Montana Power Will Soon Start Its Morony Plant

WITHIN an extremely short time the Montana Power Company, with headquarters in Butte, expects to complete its Morony hydro-electric project on the Missouri River, 15 miles below Great Falls, Mont., and 5 miles below the company's Volta power house. The Morony power plant is the eighth generating station that has been erected by the Montana company on the Missouri River.

The Morony project, named in honor of the late John G. Morony, one of the founders of the company, consists of a 90-ft. concrete dam of the gravity type, which forms a storage reservoir of 2,000 acre-ft. capacity, and a 62,000-hp. power house. The power-house equipment consists of two 31,000-hp. I. P. Morris vertical reaction turbines, operated under an 82-ft. head, and two 25,000-kva. Westinghouse generators.

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Coal and Concord Figure in Boston Edison Inquiry

CHARGES that the Edison Electric Illuminating Company of Boston paid an exorbitant price for the coal consumed by the company in 1927 and 1928 were made by Wycliffe C. Marshall of Watertown, counsel for consumers, before the State Department of Public Utilities recently when hearings on the new rates established by the company were resumed. The company disputed the assertion.

Later Mr. Marshall requested information from the company concerning its offer for the Concord municipal plant and the arrangements made to supply that town with electrical energy. The lawyer called the company's offer of $600,000 for the plant "outrageous" and said:

"As the law now stands, the Edison company may puchase the Concord plant without obtaining the approval of the Public Utilities Department. The company and the town have reached some kind of an agreement about service and the department cannot pass upon this except in connection with the rate pro-

ceedings before it. It is therefore essential for the entire transaction to be publicly scrutinized."

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Fifth Annual Sign Week Set for March 10 Next

REFURBISHING of electric signs and installation of new ones will be pushed as a joint activity of the electrical advertising committee of the N.E.L.A. and the Associated Sign Makers of America during the week of March 10 next. The proposal is that this week be given over to cleaning, relamping and dressing up signs and that electric light and power companies shall make special displays of signs and sign accessories and concentrate on their sale.

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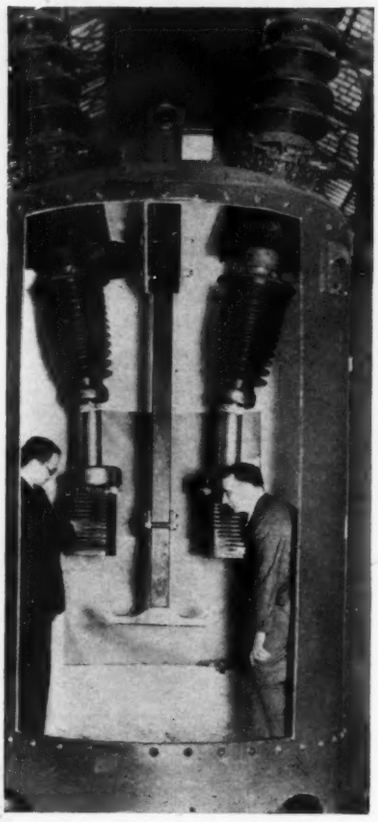
Electric Pumping for Colorado River Water

THAT a large block of continuous power from Boulder Dam will be needed for operation of the Los Angeles aqueduct is indicated by the preliminary report made to the directors of the Metropolitan Water District by the board of review appointed to select the most feasible route for the proposed aqueduct to bring water from the Colorado River to southern California. This report recommended the elimination of all the so-called gravity routes from further consideration and requested more detailed engineering and geological information concerning the four tentatively selected pumping routes.

The report says: "The only present practicable supply of water from the Colorado River is to be obtained as a pumped supply through an aqueduct so located as to take full advantage of the topographical features of the country through which it passes, always keeping the pump lifts down to the lowest practicable minimum and bearing in mind the desirability of connections which may be made in the future for the purpose of eliminating all or a large part of the pumping lift."

The board, composed of A. J. Wiley, consulting engineer of Boise, Idaho; Richard R. Lyman, consulting engineer of Salt Lake City, Utah, and Thaddeus Merriman, chief engineer of the Board of Water Supply, New York City, has the option of selecting the most feasible aqueduct route, either from the 56 routes officially proposed by the Los Angeles Bureau of Waterworks and Supply or from the several others suggested by private engineers.

UP-TO-DATE BREAKERS



P. & A. Photo

B. P. Baker (left) and J. Slepian, both of the Westinghouse company, told the A.I.E.E. winter convention how new oil circuit breakers should be built or old ones modernized.

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Public Ownership Movement by Oregon Grange

PRELIMINARY articles for an initiative vote on a constitutional amendment authorizing the creation of "people's utility districts" for the purpose of developing hydro-electric power have been filed by the Oregon State Grange. The proposal is that such districts shall embrace territory, contiguous or otherwise, within one or more counties and consist of an incorporated municipality or municipalities, with or without unincorporated territory. These districts shall supply water for domestic and municipal purposes, for the development of hydro-electric power and for the distribution and sale of water, water power and electrical energy.

This is the second time that the Oregon Grange has attempted to place the state in the electricity supply business, the first effort having been overwhelmingly defeated. The present petition will appear on the ballot next November if a sufficient number of signatures are obtained.

Adherents of the Democratic party, at a pre-primary meeting in Portland, went on record as favoring public ownership of hydro-electric power and for the more stringent regulation of utilities.

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"Adirondack Plan" in Favor in New York State

HEADED by Floyd L. Carlisle, chairman of the Niagara-Hudson Power Corporation board, representatives of New York utility companies have presented to Governor Roosevelt's agricultural advisory commission a program to speed rural electrification development in the state. The plan sponsored is the "Adirondack plan," already in force in some districts, which calls for a minimum payment of $24 a month for each mile of transmission line.

It was reported to the commission that on January 1 of this year 53,000 farms in the state were using electric service, an increase in the last four years of 72 per cent. It was also reported that New York State ranks second only to California in the number of farms served with electricity and at the present rate of growth would pass California this year.

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Michigan Makes Strides in Rural Service

ALL records for the extension of electric light and power to Michigan farms were broken in 1929, Prof. H. J. Gallagher, Michigan State College, has announced. Service was brought to 6,000 farmers this year, making a total of 19,000 now receiving central-station service. There are now about 4,100 miles of rural service lines in the state. In the upper peninsula about 800 farms are served. The same rate of progress maintained for the next seven or eight years will see the greater number of Michigan's 190,000 farms electrified.

The Detroit Edison Company built 275 miles of rural line last year and added 1,080 farm customers. It now has a total of 1,456 miles of rural lines and 8,800 farm customers. More than one-third of the farms in its territory are electrified. The Consumers Power Company has built 660 miles of rural lines since February, 1929, and has added 3,307 farm customers. Its farm lines now total 1,874 miles, and it serves 5,913 farm customers. The Michigan Electric Power Company

more than doubled the number of its farm customers in 1929, reaching a total of 1,190 farms with 188 miles of service lines. The Indiana & Michigan Electric Company has 235 miles of farm lines, serving 1,025 farms.

The Michigan Public Service Company has made application to the Michigan Public Utilities Commission for permission to adopt a farm-line building policy similar to those followed by the Detroit Edison Company and Consumers Power Company. The total line building costs under this policy would run between $1,000 and $1,400 a mile, with refunds of $100 per customer for all farmers taking service when the line is completed.

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Ohio Making Progress in Rural Electrification

IN AN address before the Ohio State Grange, held recently at Portsmouth, Governor Cooper told of the efforts being put forth for extending electrical service to the rural districts of that state. He said:

At my suggestion a complete study has been made by the Public Utilities Commission of rural electrification. Applications made to the commission by groups of farmers, under the leadership of the Grange and the Farm Bureau, for extension of power lines into the country districts, prompted this action. In the past promotion companies, formed for the purpose of exploitation rather than to give service to rural Ohio, have proved all too costly to the farmer, and as a result no real benefit accrued to the farmers. The Public Utility Commission, in co-operation with responsible public utility companies, is undertaking to provide for the extension of power lines into rural communities without burdening the farmer with whatever cost there may be for such construction. The rural subscriber for this service will guarantee for a certain definite time a minimum monthly payment which will ultimately take care of the cost of extension of the lines. As new subscribers are added, an adjustment is made in the minimum monthly cost.

The farmer under this arrangement will not be compelled to make a large immediate outlay. Instead he makes use of the money which he would have to pay under the old system for the purchase of labor-saving devices, extending the power service for machinery, water supply, operation of the dairy, modern lighting system, numerous household appliances and various other activities of the farm.

Rural electrification was discussed also by State Master Walter F. Kirk of the Grange, who said that the Ohio Power Company, the Pennsylvania-Ohio Company, the Toledo Edison Company, the Lake Shore Power & Light Company and the Suburban Light & Power Company have agreed on a policy of rural extensions.

Coming Meetings

Artistic Lighting Equipment Association—Washington, Feb. 9-15. C. L. Benjamin, 420 Lexington Ave., New York.

Empire State Gas and Electric Association — Commercial Section, Rochester, Feb. 13 and 14. C. H. B. Chapin, Grand Central Terminal, New York.

Northwest Electric Light and Power Association — Commercial Section, Spokane, Feb. 13-15; Accounting Section, Portland, March 17-18; Engineering Section, Aberdeen, Wash., March 26-28. B. Snow, 1206 Spalding Bldg., Portland, Ore.

North Central Division, N.E.L.A.—Engineering Section, Nicollet Hotel, Minneapolis, Feb. 24-25. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Oklahoma Utilities Association — New Tulsa Hotel, Tulsa, March 11-13. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Illinois State Electrical Association—Hotel Abraham Lincoln, Springfield, March 19-20. George Schwaner, 205 Illinois Mine Workers' Building, Springfield.

Pacific Coast Electrical Association—Commercial Section, Fresno, Calif., March 20-21. G. T. Bigelow, Southern Sierras Power Co., Riverside, Calif.

Southeastern Division, N.E.L.A.—Bon Air-Vanderbilt Hotel, Augusta, Ga. April 15-17. C. M. Kilian, 207 Bona Allen Bldg., Atlanta, Ga.

Middle West Division, N.E.L.A.—Fort Des Moines Hotel, Des Moines, Iowa, April 23-25. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

National Electric Light Association—San Francisco, June 16-20. A. J. Marshall, 420 Lexington Avenue, New York.

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Intense Rivalry Between 1930 Refrigerators Seen

COMMERCIAL warfare between rival manufacturers of electric refrigerators is predicted for 1930. Last year 630,000 household refrigerators are said to have been sold by the General Electric, Frigidaire, Kelvinator and other makers, an increase of almost 35 per cent over 1928. This year the Westinghouse company is entering the field with a product priced about the same as that of the General Electric. In April, however, the contest may wax warmer yet, for the Grigsby-Grunow Company of Chicago, maker of the "Majestic" radio set, is due at that time to take part in the food-preservation contest with a "Majestic" refrigerator, to be sold, it is rumored, as low as $100.

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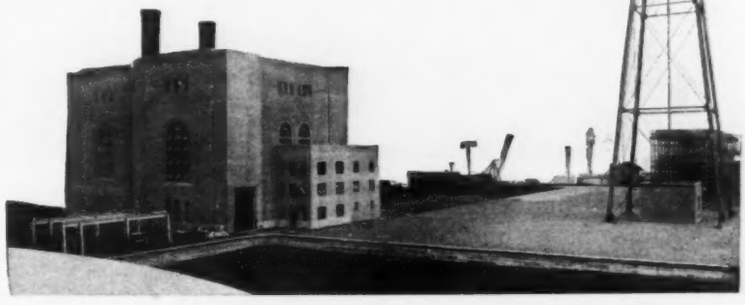
Structural Arc Welding Receives Impetus

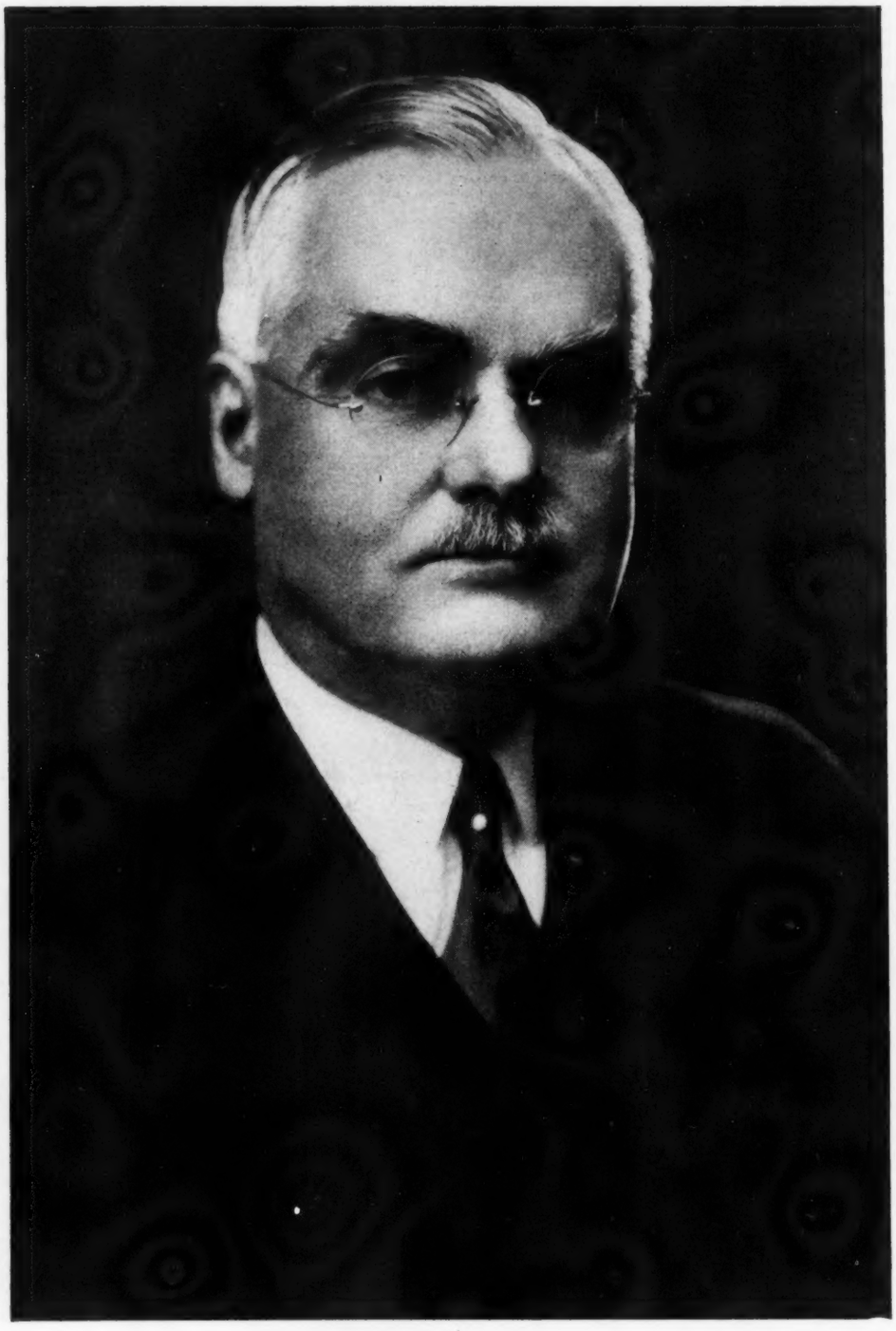
EVIDENCE that arc welding as applied to the structure of buildings is being placed on an economic basis and has come to stay is contained in the announcement that the Austin Company, a large fabricating and building firm, will add an electric welding department to its Cleveland fabricating plant and will do electric welding as a regular part of its service, making welding or riveting optional with the owner of the building that is being erected. The company's plans provide for a 50 per cent increase in the facilities of its fabricating plant to permit the installation of electric welding equipment. Complete field welding equipment will also be provided.

Engineers of the Austin Company have conducted tests over a period of several years, and these have convinced them that welding is destined to have a substantial place in the fabrication of structural steel, according to the announcement by W. J. Austin, president. The company will use the equipment made by the Lincoln Electric Company of Cleveland throughout.



GREAT WESTERN POWER'S NEW PLANT

The 35,000-kw. steam plant of the Great Western Power Company, situated at Indian Basin, on the shore of the bay in the southern section of San Francisco, went into operation during the first week of December.



HAROLD B. SMITH

Professor of Electrical Engineering Worcester Polytechnic Institute

PRESIDENT

American Institute of Electrical Engineers

EDITORIALS

L.W.W. MORROW
Editor

Engineering Pressure Makes Industry Move

THE United States has a new political economy, with mass production, high wages and low prices as fundamental principles. This new political economy has become possible only because it is built upon the engineer and his works. It is the assembly of machines and power that underlies both commercial activities and social habits.

Last week the electrical enginering profession met at the winter convention of the American Institute of Electrical Engineers. More than two thousand electrical engineers listened to half a hundred papers on many diverse topics and discussed engineering problems and new engineering developments. It was a "highbrow" meeting to the observer, apparently made up of a mass of technical material with detailed technical discussions. These are meat and drink to the engineer.

But there is a deeper industry significance to a meeting of this kind. It stands for engineering progress, and this in turn means commercial progress. One new engineering idea may start a development that will produce an industry in a few brief years. Witness the automobile, the vacuum tube, the electric lamp and the ultra-violet light.

National prosperity is bound up with the development of new engineering products and ideas. The engineer is always looking ahead toward perfection. He makes commercial and industrial stagnation and decay impossible. His works impart stability to our new national political economy. These are the significant backgrounds of an outstanding meeting of technical electrical men.

Economic Issues Entice Engineering Skill

BANCROFT GHERARDI'S remark to the A.I.E.E. convention that when telephone service becomes worldwide the remaining problems will not be those of the engineer but of the sociologist ought not to be taken too seriously. Long after the electrical industry achieves a measure of technical attainment comparable to the pot of gold at the grounded end of the rainbow as viewed from the base line of present development the engineer will be sought to reduce unit costs of service to ever lower levels. In the colorful days yet to come the vistas of engineering progress may reveal a diminishing rate of return upon work directed toward increasing the efficiency of speech and power transmission, but it is hard to conceive of a horizon imposing final limits to economic attack on such adversaries as investment outlay, operating expenses, depreciation and its twin brother obsolescence. In other words, the profession of electrical engineering has a long way to travel beyond purely technical accomplishment before its front-line practitioners will have to take down their shingles and clear out their desks for the benefit of the junk dealer.

The social aspects of improved electrical development and service are already of great importance, and Mr. Gherardi's proper emphasis upon these should not be misinterpreted as depreciating the future usefulness of the engineer. As Colonel Jewett pointed out at the same session, the advance of applied science is overthrowing the language barrier between nations. All the proceedings of the recent World Engineering Congress at Tokyo were in English, although 28 or 30 nations were represented.

International telephony bids fair to exert an

influence upon world *entente* difficult to exaggerate. Along with the racial and national aspects of cosmopolitan electrical progress runs the ever-present problem of economic control of developments. The complex structure of modern electrical systems is a perpetual challenge to the engineer to establish and maintain lower unit costs. So far as can be seen, enough work lies ahead in both the technical and economic phases of every kind of electrical service to absorb the best abilities of the engineering profession for many decades to come.

When the First Shall Be Last in Lighting

BY WHAT irony of fate does it sometimes happen that the places designed for the occupancy of the mighty are much less comfortable as far as their lighting is concerned than those for the rank and file? A large corporation plans a new building. In its employ are a number of men familiar with the essentials of good lighting and knowing how to get it. Earnest study is given to the provision of lighting throughout the building that will be conducive to the comfort, efficiency and cheerfulness of the employees; that is, until the president's and directors' rooms are to be planned. Here let none of the common technicians in the company's ranks interfere, for this is where the architect obtains one of the few opportunities to express his art—or perhaps the president has ideas of his own.

Some evening the building is opened to inspection and the president's and directors' rooms are found to be no place for sore eyes. On every hand glaring light sources are painfully silhouetted against backgrounds of expensive dark-colored woods. Glare and gloom abound. Perhaps after the building has been occupied for some time the directors get tired of their sacrifice to "art for art's sake" and a new administration makes a change to something more conducive to peace and harmony in the board meetings.

A great railroad company builds some club cars which are supposed to be the last word in railroad-travel comfort. Now, railroad-coach lighting has been thoroughly studied, and as a result excellent methods of lighting have been standardized for years. The safe trails are all well beaten and easy to find. But these club cars being something special the designer is allowed to be a law unto himself or again the pet whim or fancy of some high executive governs the design. If either the designer or the executive happens to belong to that large class which still considers lighting a matter of incidental importance, one is apt to find in the club car either an attempt at indirect lighting from a very dark-colored, polished ceiling or decoration with glaring exposed bracket lamps against a background of black walnut. The club car, instead of being the most comfortable car on the train in which to spend an evening, becomes the least comfortable.

These are not isolated cases but have been repeated with slight modifications numerous times. The moral? One reader will say: "Lack of lighting consciousness in high places." Another will say: "One department of a large corporation knoweth not what another department doth."

Engineer-Specialist and Manager

TWO very different types of engineers are needed by the electrical industry today. The trends in the art and the development of very large business branches based on the use of engineering equipment and methods have modified and changed the requirements of engineering. Design, operation and management are equal in value.

What might be called technical engineers are sought in comparatively small numbers. These men are needed to develop machines, conduct research and solve technical problems encountered in operation. In large measure they work alone and should have a college preparation far in advance of that afforded by the normal engineering undergraduate course. Electrical science is far advanced, and yet the hope of future progress is tied in a fundamental manner to new technical advances. The industry and the schools should see to it that these types of engineers are trained and are paid full value for their work. There is a very inadequate supply of them at present, and

industry grants very little premium to those who take graduate work in science and engineering.

A second type of engineer is needed to manage and operate the business branches that are founded on engineering. These men should have college preparation in economics, engineering, psychology and the humanities. Their task is to weld together human beings and engineering equipment to get economic results. Very few should work as individuals, and technical specialization is impossible. These engineers are executives and are called upon to exercise balanced judgment on business problems.

What might be called the engineer executive is demanded in increasing numbers. But the schools are doing little to supply the need or to co-operate in the business training that is needed after graduation. Industry itself does very little to train its future executive staff. Both the schools and industry are too prone to close their eyes and give all students the normal engineering course of "sprouts." This means four years of engineering education, in which the technical features still deal largely with machine design, followed by a year or two of apprentice work wherein the old slogan "Start at the bottom" is followed rigidly. An inefficient attempt at specialization for all men is started in the schools and followed in industry, and it is no wonder that many young engineers are smothered before they awaken to modern conditions.

It would seem well worth while to better production methods in engineering education. The schools could profitably study the market and then make their courses fit industry needs by training a small group of thorough scientists and engineers and a large group of young men well grounded in fundamental science, engineering, economics and cultural subjects. And the schools can go beyond this. They can establish co-operation with industry whereby the specialist shall be placed properly and advanced properly and whereby the large group of budding executives shall be placed properly and trained properly to supply the needs of management. Industry could well co-operate with the schools in the accomplishment of these objectives and in addition can do much to place, to train and adequately to pay the two classes of engineers needed. Nothing is more fundamental to the progress of the industry than an adequate supply of trained men.

Plan the Market—Ten Years from Now

AN INTERESTING point came out of discussion at recent meetings of the N.E.L.A. merchandising sales committee at Birmingham. The meeting was considering the electrification of new homes and the possibilities for establishing complete electrical equipment as the standard for new dwellings, installed as the house is built and financed under the mortgage. It was agreed that no man who has watched the rapid standardization of the modern bathroom can well doubt that the day will eventually come when public demand will put all the major domestic appliances into increased use and natural obsolescence will provide an enormous market, to prosper the manufacturers, wholesalers and retailers of the electrical industry. Then the questions were raised, When can this condition of universal use be expected? And how are the power companies planning for this development?

Ask the system engineer what his expansion program is for the next ten years and he can tell you. He knows, within a row of apple trees, which extension will come next and next. He has visualized the growth of his operations into the future. So has the financial man. He also knows with some degree of accuracy how the financial structure of the corporation is to progress. Refinancing is plotted well ahead, and the new capital that will be required to float the engineering program is all scheduled. But the sales program of most companies has never been projected into the future in the same way. Because of the insistent growth of the market, backed by the advancing pressure of public interest and demand, sales plans have for the most part been set up from year to year, from hand to mouth. The expected increase of load has been calculated. The trend of community development has been estimated. But there have been no five-year or ten-year objectives in sales policy. At the Birmingham meeting this fact was admitted and discussed with keen interest.

What is to be the market picture ten years from new? Industrial heating, ventilation, lighting, heating, cooking and complete labor-saving equipment in the home, railway electrification, highway illumination—what are the possibilities and how should present sales policies be shaped?

Courtesy Westinghouse Electric & Manufacturing Company

SERVICE RELIABILITY Motivates A.I.E.E. Convention

NEW developments provided the foundation for ten technical sessions at the American Institute of Electrical Engineers' winter convention in New York City last week. Some of the developments were in the realm of physical apparatus designed to meet the exacting needs of the industry and some were in the realm of research and abstract theory. The significant feature of the papers and discussions was the fact that all fields of interest to the electrical engineer are active in pushing the frontiers of knowledge outward. The practically minded operator found as much to interest him as the theoretically minded designer. The attendance was greater than last year and interest was manifest from the opening to the concluding session.

On Monday it was brought out that metal-clad switchgear—a radical departure from the conventional open-bus construction—promotes safety and standardization but has definite economic limits of application. Discussion of lightning at a subsequent session aroused some doubt regarding whether sole reliance can be placed on lightning arresters, but this session presented facts on new materials for and performance of arresters assuring a higher certainty of functioning. Likewise the "Deïon" principle announced last year for air circuit breakers has now been extended to the oil circuit breaker in the higher voltage ranges. The newer ultra-violet light sources were discussed at the evening session, emphasis being placed on the energy content and wave-length limits. The authors and discussors were careful to avoid making inordinate claims for the therapeutic merits of these light sources. On the contrary, they pointed to the deleterious results if unintelligibly applied.

The following day opened with a discussion of the methods of attack employed by several of the metropolitan power companies in analyzing the

adequacy and reliability of their present systems and means of expansion to be provided to meet the greater loads of the future. Three abstract papers were presented at the afternoon session analyzing the inconsistency in present magnetic units and generalizing on theory involving induced voltages in conductors and windings. A fourth paper described the improvements in the cathode-ray oscillograph involving a single-sweep time axis and which is self-starting on the impulse of the surge to be recorded.

Eight papers on lightning were sponsored by a subcommittee of the committee on transmission and distribution at the Wednesday morning session. These were largely a report on last summer's intensive field study of natural and artificial lightning on energized and de-energized lines, qualitatively and quantitatively, empirically and abstractly. The provision of defense against lightning outages is certain to be facilitated by the increased grasp of the character of lightning surges revealed in this presentation. The discussion was unusually vigorous and comprehensive, extending into a special Thursday morning period. The Edison medal was awarded to Charles F. Scott in the evening.

The latest forward strides in the field of transoceanic communication now linking us with all but 15 per cent of the world's telephones were brought out on Thursday. Parallel sessions in the afternoon were devoted to the theory and practice in the welding field and to new disclosures regarding dielectric phenomena in oil, air and paper. The electrical machinery committee conducted two sessions on Friday devoted to a broad group of subjects, including temperature limits of transformer loading, load control, inversions in autotransformers, reduction of noise in motors, ventilation of large units and generalized theory of design and short-circuit behavior.

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Planning for System Growth

How three cities are laying out their systems for the future. Effects of governor action on system stability and phase-shifting control at interconnection points

THE culmination of several years' work to develop a basis for approaching the problem of building for the future was represented by three papers presented at the system planning session. They concentrate separately on the features of the Chicago, Detroit and Philadelphia systems respectively.

Two other papers presented at this session dealt with two important problems involved in operating interconnected systems—effect of turbine governors on system stability and avoiding out-of-phase relationships between points of network that must be connected. Solutions and their efficacy were submitted. As H. R. Woodrow said in discussing the planning papers, their outstanding feature is that they and the discussion provoked indicate more thought is being given to planning. Other speakers declared that the papers collectively are intensely valuable.

Attention was called to conditions that influence the character of systems being developed in the territories considered, including the nature of the territory to be served, the character of the load, the availability of power sites and power supply, the relative magnitude and geographical distribution of residential, commercial and industrial loads, the service standards, the nature of the existing systems and major equipment, factors affecting the selection of transmission voltages and size of generating units, short-circuit possibilities and the problems of maintaining reliable service at reasonable cost. However, each of these subjects was not discussed to the same extent by each author, some merely citing conditions, others pointing out briefly how they influenced the fundamental principles back of the plan.

Emphasis was placed in nearly all the papers on the engineering features adopted to assure continuity of service and economy of operation. With a few exceptions little was said regarding the relative merits of future power sources, how the existing transmission systems and major substations will fit into the system of the future, or how distribution substations and low-tension distribution will be adapted to territorial changes in load growth.

As M. J. Lowenberg pointed out in discussing the papers that three different forms of system development were related—that in Detroit being built on the basis of a separate generating station for each power zone loosely coupled with adjacent zones, but with the power stations interconnected solidly; the Philadelphia system, in which tight coupling is employed between power zones and generating stations, but any faulty unit can be isolated quickly, and the Chicago system, which involves two, or possibly more, rather distinct systems, any of which can assist any section in an emergency.

The Chicago system

The Chicago system, described by George M. Armbrust and Titus G. LeClair, serves a city area of 209 square miles and an adjoining suburban territory of about 400 square miles and more distant widely scattered towns, bringing the total area up to about 6,000 square miles. The average load density for the city proper is approximately 5,100 kw. per square mile, but for the total area it is only about 230 kw. per square mile.

At present 321,000 kw. of direct-current load is supplied from the 25-cycle system, but no 25-cycle generating capacity has been added to the system since 1920, most of the increase in load being taken on the 60-cycle system. The 60-cycle system involves about 303 substations, totaling 1,414,000 kw.

Within Chicago proper the generating stations are rigidly tied together by two 66-kv. sectionalized tie lines or buses, composed of single-conductor cable. Connected with this bus at strategic points throughout the city are the major substations which step down the voltage to 12 kv. for load-center substations. To serve substations in the outlying parts of the Chicago region 33,000-volt lines are used. Surrounding the city is a 132-kv. ring which ties into the 66-kv. system at several points and extends outward to interconnect stations more remotely located.

As the future increases of generating capacity within the city are limited, an increasing proportion of the energy required will come from stations outside, some at considerable distances. Transmission of large amounts of energy from the more remote sources into Chicago will be by means of overhead lines of 132 kv., 220 kv. or higher, stepping down to 66 kv. at points near the load centers. With the development of outside larger generating stations and limited rights-of-way, circuits must be designed for and operated at maximum loading.

Detroit layout

In Detroit the average load density for the general business and commercial area in the center of the city is 25,000 kva. per square mile. Industrial areas are distributed in a rough circle around the heart of the city and at some distance from it and have an average load density of 17,000 kva. per square mile. Between the commercial and industrial districts is the residential district, having load densities ranging from 60 kva. per square mile to 4,500 kva. per square mile.

Two of the generating stations are within the city load area and consequently deliver energy at 24,000 volts. Two others of very modern design are more remotely located from the load areas and are consequently connected by double-circuit 120-kv. lines running around the outskirts of the city, being connected with transmission substations and interconnected with adjacent companies. These substations are connected to the load-center substations within the loop, which in turn feed into the 24-kv. system.

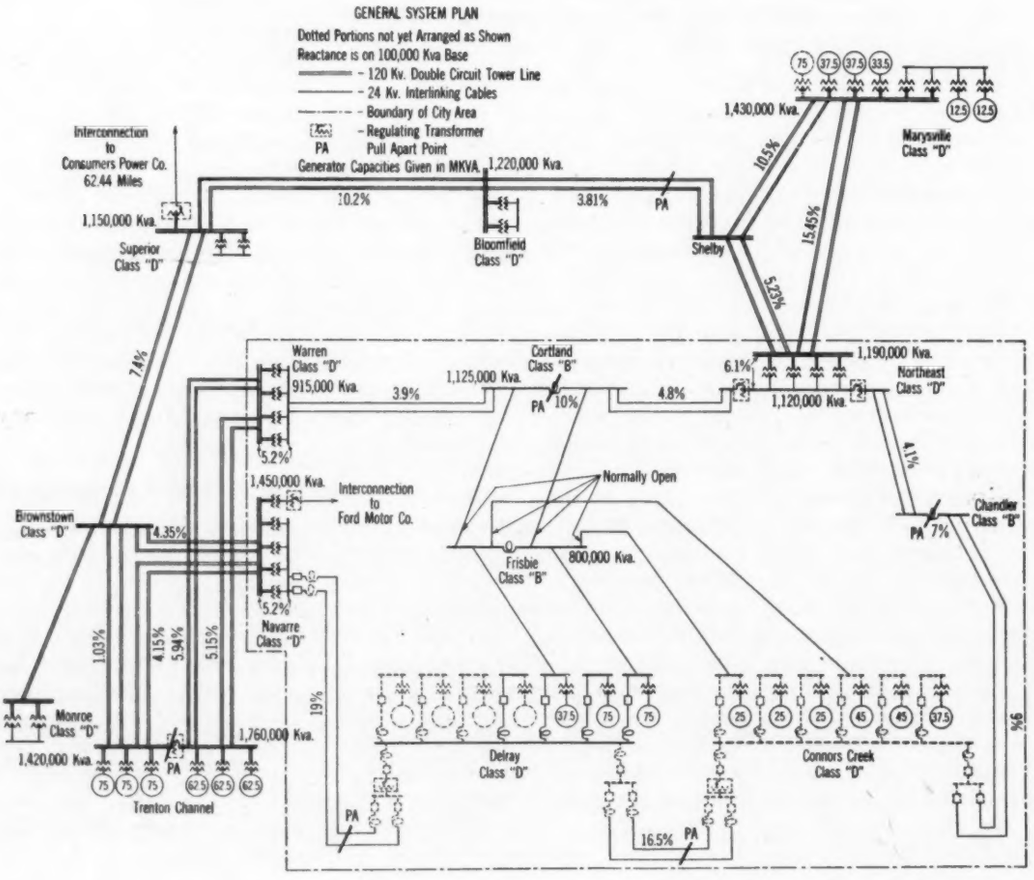
The underlying principles which served as guides in developing the Detroit system follow:

1. It is not necessary or advisable to operate the electrical system as a single unit, but rather as a group of power areas, each served by its own power house or large step-down substations. These power areas shall be loosely connected for the purpose of synchronizing and interchange of power, but so arranged that when an uncontrollable disturbance breaks loose in any power area that area shall disconnect itself from the others, taking with it only its own load area. The boundaries of these power areas shall be flexible, to permit reducing the size of an area while reconditioning generating equipment.

2. A system should be capable of indefinite expansion without major changes. This requires that the system be designed for the maximum short-circuit duty consistent with available switchgear.

3. A simple system is essential that may be practically operated and is not susceptible to faults through sheer mass of equipment involved.

4. Substations and generating stations should be reduced to a minimum number of standard types and sizes, employing, so



120-kv. loop around Detroit ties generating stations with step-down stations feeding into system and also with outside power sources

far as conditions will permit, standard equipment.

5. Since most serious electrical operating troubles arise from malfunctioning of switchgear or accessories, it is advisable to eliminate as much switchgear, bus work and accessories as possible.

6. So far as possible, reactors should be avoided in feeders, using them rather for sectionalizing purposes.

Philadelphia layout

The average load density for the Philadelphia area, excluding railways and utilities, is about 480 kva. per square mile, but a demand of 22,000 kva. per square mile exists in the central district. The city residential load density is approximately 2,000 kva. per square mile.

Fundamental plans provide for 13.2-kv. and 33-kv. major distributing centers at generating stations and other points from which energy is transmitted directly to large customers or substations for redistribution. The major distributing centers are normally tied together with relatively high-capacity lines to utilize the power from the more efficient steam plants, hydro stations and 220-kv. interconnections. So far as practical, sufficient generating capacity is connected with the large load centers to carry the zone loads under emergency conditions.

Owing to condensing water requirements most of the generating stations have been located along the Delaware River, although recently hydro power has been brought in from Conowingo to a 220-kv. substation, lines from which connect with the Pennsylvania Power & Light Company and eventually with the Public Service Electric & Gas Company of New Jersey at the same voltage, while the generating stations of the Philadelphia company are tied in with 66-kv. lines.

In general, the city substations are fed by 12,000-kva. tie lines from different distributing centers in order to provide emergency service in case of failure of any one distributing center.

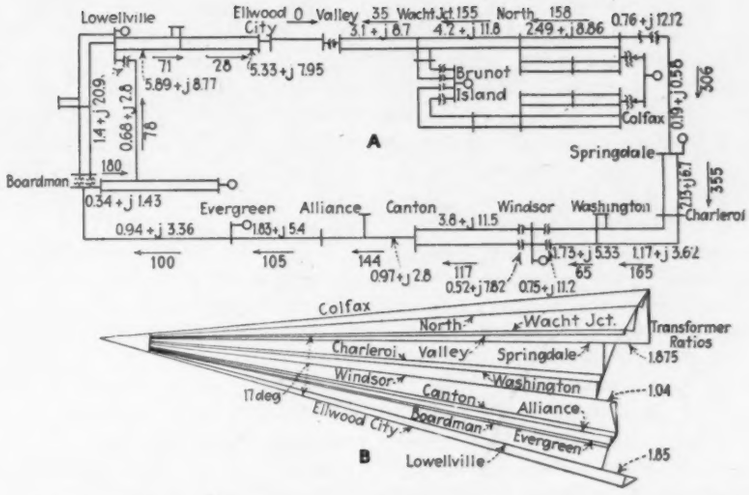
The basic principles used in developing the Philadelphia system are as follows:

1. The various elements of the system should be arranged, so far as practicable, so that failure of any one will not interrupt service or lead to a severe widespread disturbance. In the case of distribution feeders, this is not practicable except where the load densities are high enough to warrant networks.

2. Generating centers, so far as practicable, should be so located with respect to the load that in case a tie line opens each generating center will be self-sustaining.

3. Sufficient transfer of power should be allowed throughout a system so that generating stations can not only be located to secure maximum economy but also minimum generating capacity to care for emergencies.

4. Expansion should be facilitated so peak loads can be handled without retiring existing equipment due to increased duty or operating inflexibility.



Phase differences between points on Penn-Ohio network that must be occasionally interconnected

Boston and New York systems

In the discussion of these system planning papers the general features of the Boston, New York and Baltimore systems were also brought out. For example, I. E. Moultrop pointed out that Boston has separate power zones, loops through major substations, tightly linked tie lines, relief cables between zone boundaries, substations adjacent to generating stations, split buses, high-voltage rings and sufficient flexibility to permit changes indicated by operating experience.

In Brooklyn, H. R. Woodrow pointed out that generating stations have been divided into a multiplicity of units which are paralleled as near the load as possible through multiple connections. Since each substation section is fed from a different generating station section, any station can be lost without affecting service. He maintained that electric service companies should be more interested in the continuity of service to the customer than in the continuity of individual generator operation.

Commenting on the present situation, he declared it is important to omit as much high-tension switching as possible. Looking into the future ten years present equipment will represent a small portion of the total investment, probably one quarter. Consequently whatever is done in system planning should give proper weight to existing investment.

One very important fundamental which should be decided upon, declared A. H. Kehoe, is the percentage of reserve to total load.

E. C. Stone contended that all systems have some elements in common, such as generating stations, tie lines, and loads, so that fairly definite planning can be based on these factors, even though local conditions may affect the details. At present, he maintains, systems are too complicated, switches and substations are too elaborate and the intermediate voltages are too low. In the next ten years he anticipates considerable changes in fundamental plans, because, as reliability of equipment improves, it will not be necessary to provide so much reserve and systems may be simplified.

Two speakers called attention to the necessity of giving more attention to the planning of low-density distribution areas that may grow in load, the possibility of adjacent systems developing into interconnected systems and the necessity of co-operative planning by engineers in adjacent sections. D. K. Blake contended that there is no system which will meet the low-voltage distribution problem so well as the alternating-current network.

Closing the discussion on the system planning papers, S. M. Dean,

author of the Detroit plan, pointed out that territories which cannot have adequate generators for each load zone cannot use loose linking and emphasized the seriousness, especially on loose-linkage systems, of building generating stations that cannot be kept up to date. The ideal procedure would be to add modern units at one end of a station and remove the old ones at the other end. Raymond Bailey, author of the Philadelphia plan, urged more study of the economical size of generating stations and prophesied that sections of loosely linked systems may become more closely linked in the future, since with growth the size of one element becomes less important.

Effect of turbine governor response on stability

To determine the effect of turbine governor response upon stability three series of tests were conducted by the Duquesne Light Company and reported at this section. They involved the determination of the national period of turbine-governor and system oscillation and the action of governors during a surge caused by pole slipping or the like. The authors concluded that the periods of the governor and load oscillations on the corresponding generators did not have a time phase that would sustain a surge. The natural governor period was fast enough to eliminate the effect of variations between steam input and load output. The governors were sensitive enough to keep the turbines from overspeeding during a pole slip.

Phase shift between tie points

The final paper, also presented by a Duquesne Light engineer, showed by vector diagrams based on the company's network the magnitude of phase difference which may exist between points on a network before they are interconnected and submitted methods of compensating for this phase shift. When systems of the same frequency are interconnected directly or through transformers the load control and phase shift could be obtained by a tap-changing regulator connected for quadrature voltage action. If voltage and reactive conditions are undesirable on either or both interconnected systems, indicating the necessity for synchronous condensers, a synchronous-synchronous frame-shifting motor-generator might be used.

Since a three-phase voltage regulator produces a phase shift, the application of two such devices in series will often make possible the control of both power and wattless kva. This scheme could be applied to low-voltage and medium capacity tie lines, but probably is not economical in large applications.

Where the interconnection between systems is of different frequency, a motor-generator set is required and the power control can be secured by a frame-shifter of the synchronous type or by the use of an asynchronous machine if it is not necessary to maintain rigid phase relations.

In any event, the necessary range of phase shift can be readily determined by the methods shown in the accompanying illustration.

These papers were not discussed as extensively as the system planning papers. Mr. Lowenberg reported tests which indicated that sudden complete unloading of a generator caused it to accelerate faster than the governor valves could shut off the steam supply, whereas sudden half unloading would not cause the generator to accelerate fast enough to create this situation. However, most machines overshoot the governor action. To avoid this trouble the speaker recommended flyball speed indicators for governor control and powerful, quick-acting engines to operate the valves.

Papers at Planning Session

System Connections and Interconnections in Chicago District, G. M. ARMBRUST and T. G. LE CLAIR, *Commonwealth Edison Company*

Fundamental Plan of Power Supply in the Detroit District, S. M. DEAN, *Detroit Edison Company*

Fundamental Plan of Power Supply in the Philadelphia Area, RAYMOND BAILEY, *Philadelphia Electric Company*

Turbine-Governor Tests at Colfax Power Station, T. C. PURCELL and A. P. HAYWARD, *Duquesne Light Company*

Controlling Power Flow with Phase-Shifting Equipment, W. J. LYMAN, *Duquesne Light Company*

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Fundamental Units Inconsistent

Calculation of induced-voltages in metallic conductors and electrical machinery, design and application of cathode-ray oscillograph with Norinder relay

"IT IS surprising, on account of their large use, that such great divergences of views on the values of magnetic units should exist." This comment, echoed in tenor by others who entered the discussion, was made by A. E. Kennelly in reference to the matter concerned in his own paper on the reaction of the subcommittee on magnetic units of the International Electrotechnical Commission to the Italian proposal made in 1927 at the Dellagio meeting to establish a new international unit of magnetic flux. This unit was proposed for "the practical system" to have a magnitude of 10 to the eighth power c.g.s. units, corresponding to the "volt-second" and be given the name "Maxwell." It was the conclusion of the subcommittee of which Mr. Kennelly is chairman that the proposal be not recommended, "in view of the dislocation in understanding of electromagnetic literature that might thereby be brought about." The subcommittee also found "that steps should be taken toward unification of the definition of the magnetic units and their names," but has not arrived at an agreement as to what those steps should be. It was the purpose of Mr. Kennelly's paper to lay the situation before the Institute and invite discussion to indicate the form of concrete proposals to be offered by the subcommittee to the next meeting of the I.E.C. Mr. Kennelly made three concrete suggestions. These were:

First—Before any definite new action is taken it is desirable to standardize internationally the definitions of magnetomotive force, magnetizing force, magnetic reluctance, magnetic flux and especially permeability, so as to reach international agreement on the dimensions of permeability.

Second—It seems desirable to re-

vise internationally the assignment of names to a few magnetic units in the c.g.s. system.

Third—It would be desirable to accept part of the Italian delegation's proposal at Dellagio in 1927 and adopt "practical" unit of magnetic flux at the value of 10 to the eighth power c.g.s. units, but not to call it the "Maxwell."

In the discussion that followed the paper it was generally agreed that there was urgent need for international accord on definitions and names of magnetic units for, as was stated by E. L. Dawes, it is remarkable that these units have not yet been standardized when one considers the large amount of standardization work done on less important quantities. V. Karapetoff made a plea for practical units for the physicist as well as the engineer when in the discussion certain units suggested by him received some animadversion. To the practicing electrical engineer, concerned more with slide rule calculation than with fundamental definitions, the discussion and the paper itself were perhaps a little disturbing, as would be the disclosure to a lawyer of a basic insecurity in the legal code he uses daily.

Another questioning of accepted and commonly used practices was contained in the paper by H. B. Dwight on the calculation of induced voltages in metallic conductors. This paper presented certain restrictions on the standard rules for these calculations.

It appears that the usual visualization of inductance, as the cutting of magnetic lines of force by a conductor, contains pitfalls for the unwary. Considering magnetic fields to have velocities, the restriction is stated that in general the resultant magnetic field should not be used with the $B\,l\,v$ rule, when the resultant is made up of component fields whose velocities differ in magnitude or direction.

A most interesting general equation for induced voltages in electrical machines was presented by L. V. Bewley. The equation is applicable to machines having parallel coil sides which include in special cases single and polyphase induction motors, synchronous generators, d.c. generators, synchronous converters and static transformers. A characteristic of this equation is that no restrictions are placed on the velocity of the moving conductors or on the rate of pulsation and rotation of the flux, but these may vary in any arbitrary manner which can be given a suitable analytic expression.

In its 32 years of development the cathode oscillograph has become a measuring tool useful in many branches of electrical and even mechanical engineering covering the field of transformer design, choke coils, lightning arresters, insulation, transmission line characteristics, corona and hysteresis losses, the study of lightning and many other problems. A recent development in this type of oscillograph is the one equipped with the Norinder relay, which was described by O. Ackermann. The paper included a circuit for obtaining a unidirectional time axis on the oscillograph in which the timing movement is started by an impulse from the surge to be measured. The presentation of this paper evoked

Roving Newspaper Reporter says:

"There's a genuine sparkle to the electrical engineer."

EDITORIAL NOTE: Louis Sherwin, the "Roving Reporter" of the New York *Evening Post*, visited the convention of the A.I.E.E. and wrote his impressions in his paper on January 31.

"As for the electrical engineer, whether he is a field worker or a research man, they are magnificos to be looked upon with awe. An awe that is not dispelled even by seeing them en masse, as you can any day this week if you strolled into the Engineering Auditorium on West Thirty-ninth Street.

"Their elocution, it must be admitted, would not make Otis Skinner jealous or Alfred Lunt cut his throat. It would not even instill a proper sense of inferiority in the breasts of the United States Senate, where pronunciation, for the most part, is vile and articulation nothing to write home about.

"Oscar Wilde once observed, apropos the handwriting of Robert Ross: 'A letter from Robbie is an indication that he has something to conceal.'

"One is tempted to say the same of any eminent engineer when he gets up to read a technical paper to his peers.

"It is not merely because their discourses consist largely of phrases and formulas that sound like cabalistic symbols to the lay ear. Most of their simplest sentences are equally inaudible. They read theses that they have spent two years in preparing, they expound theories that evidently excite the profoundest admiration from their colleagues as though they were standing in the dock to make a confession of which they are heartily ashamed.

"Let it be strictly understood that this is in no sense a criticism of these distinguished men. If they were accomplished orators they would be rotten engineers. The charlatan and the swindler are always glib and eloquent. There is no cheaper article in the world than eloquence.

"But the fact that they can hear each other at all is additional evidence of their almost miraculous faculties.

"At this convention of the American Institute of Electrical Engineers you will see a body of men who are making more important news than any other profession in the world today. Small wonder we look upon them with well-nigh superstitious eyes."

considerable discussion, mostly concerned with comparisons between the Norinder development and other types of cathode-ray instruments now in use. A point of interest was contained in the appendix to the paper in a formula derived by Louis R. Smith for the sensitivity of the cathode-ray oscillograph. This formula takes into account the change of the mass of electrons at speeds approaching that of light. At the frequently used cathode voltage of 60 kv., this phenomenon causes a deviation of 5 per cent from the value which would be expected otherwise.

Papers at Fundamental Unit Session

The Units of the Magnetic Circuit, A. E. KENNELLY, *Harvard University*

The Calculation of Induced Voltages in Metallic Conductors, H. B. DWIGHT, *Massachusetts Institute of Technology*

Induced Voltage of Electrical Machines, L. V. BEWLEY, *General Electric Company*

Design and Application of a Cathode-Ray Oscillograph with Norinder Relay, O. ACKERMANN, *Westinghouse Electric & Manufacturing Company*

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Mastery of Lightning Is the Goal

The economical attainment of the lightning-proof line is the unsolved transmission problem. Studies of natural and man-made lightning greatly enlarge grasp of the solution

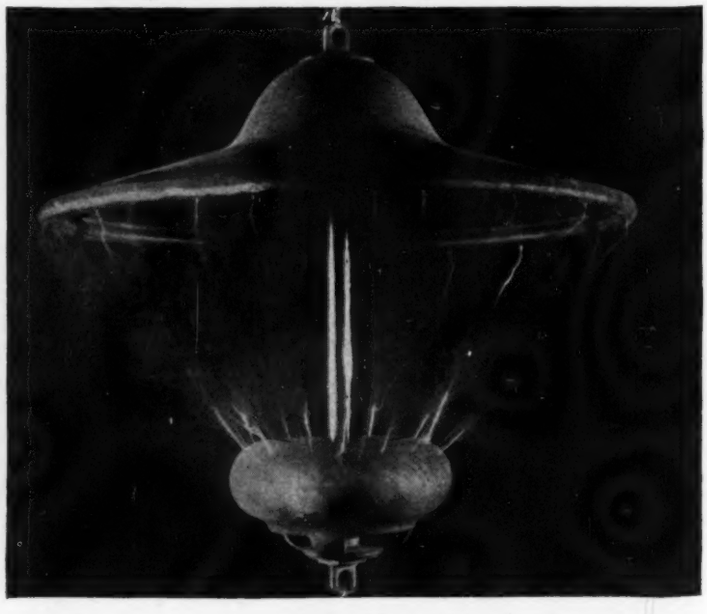
SELDOM has any problem facing the electric power profession been accorded more enthusiastic approach and vigorous attack than that of lightning as reported at the Wednesday morning session and discussed in two subsequent sessions. The complete answer has not been found; this was admitted by every one, but much of the controversial discussions of past years on the essential character of lightning surges has been supplanted by discussion in detail of the quantitative proportions of direct and induced strokes and the shape of an acceptable test wave. The papers, summarized in last week's issue, reflect a comprehensive attack on the problem, running all the way from statistical studies of storms and the attendant trip-outs, segregation of lightning and switching surges, measurements of natural lightning surges, subjection of the lines to artificially produced surges and ending with theoretical speculation as to the behavior of traveling waves. The significant aspect of the 1929 reports is the confident determination that lightning may shortly be mastered within economic limits, whereas only two years ago it was the fear of almost all that direct strokes were invariably of magnitude beyond control.

There were doubts expressed about the closeness of the oscillograph locations to the point of origin of the surges they recorded. Subsequent work will have to capitalize every prospect of planting the device at the point of stroke if the present uncertainty as to the deformation of the wave and the reduction of the crest value resulting from the travel over an unmetered portion of the line are to be eliminated. The spillovers are of course most likely to occur at the point of inception.

In his discussion A. E. Silver brought out the fact that the surveys had provided a large amount of data on the behavior of natural and artificial surges caught at random points on the lines, but urged that this progress be not confused with a disclosure of the mechanism and laws of the lightning stroke in its origin and appearance at the point of stroke on a line. For the more fundamental study distinctly different equipment and technique will be required, and these are hardly out of the development stage. Clearly to take the average of any substantial number of the recorded surges as a conception of the characteristics of natural lightning is misleading and may lead to erroneous working premises. The main objective is the protection of service reliability from spillover trip-outs, and these do not result from lightning surges after they have traveled any appreciable distance over the line.

E. P. Peck emphasized the importance of data which indicate the probability of direct strokes; these data are valuable in connection with the planning of design characteristics of new lines in territories surveyed. Attention was called by L. V. Bewley to the likelihood that the rate of voltage rise at the point of the disturbance would be nearly double that attending the passage of a wave originating some distance away. R. N. Southgate stated that the effect of corona was that of taking the steepness out of the wave front, reducing

Flashover of insulator devised by Prof. H. B. Smith



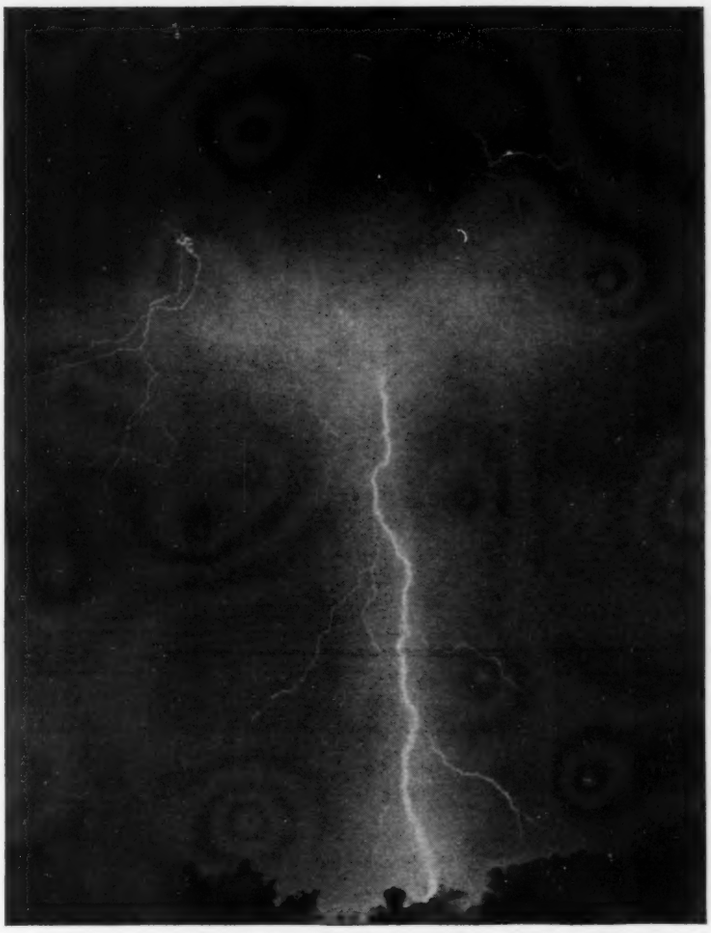
its crest value, raising the tail values and thus prolonging the wave.

The primary concern in some situations is the phenomenon of burndowns, because on inaccessible single radial feeders the resulting outages may extend to two or even twenty hours before service can be restored. According to B. E. George, there is some evidence indicating that lightning causes burndowns without the accompaniment of a following power arc. In dealing with the question of the reliability of the measurement schemes employed in the various surveys, G. E. Wade stressed the importance of careful design of the potential dividers. Thus too high a resistance may result in the suppression of some of the component oscillations. He also questioned the propriety of the use of the term "surge impedance" in connection with towers because of their short length in connection with the surge wave length. O. Ackerman, referring also to surge impedances, expressed the belief that the values were less simple than has usually been assumed and indicated an expression involving a parameter p affecting both inductance and capacitance as modified from the familiar $Z = \sqrt{L/C}$. In fact, he advocated the adoption of the term "impedance function" as a substitute for "surge impedance."

F. W. Peek commented on the information obtainable from the multiplicity of oscillograms, the promise of the direct stroke indicator with further development, and the confirmation of former conceptions of the ground wire function. Many of the protective ratios have been substantiated. Also, there has been found a close approach to the commonly assumed value of 100 kv. per foot of tower height as a maximum to be contemplated in design. Before, however, it will be possible to predetermine the effects of lightning it is necessary to have more knowledge than is now available about the intrinsic character of lightning at the point of origin. In the meantime it is quite certain that surges are being caused by both direct and induced strokes. With the higher insulations now being employed it is the direct stroke that is the more important.

A statistical study of line outages is being conducted with the aim of ascertaining the probability of outages from lightning with a given value of insulation. The tower height is a determining factor and therefore the results may be expressed in terms of the outages per insulator unit per foot of tower height. It appears that 0.8 insulator unit per kilovolt per foot of line height will effect zero outage for an unprotected line. This means 32 units for a 40-ft. height, but with ground wires giving a protection factor of 2 the sixteen-unit string would be adequate.

A cable buried 6 or 8 in. and extending 600 to 800 ft. from the tower was found by A. S. Brooks to be effective in reducing high tower-footing resistances. The use of a long-duration, slightly attenuated test wave was urged by C. L. Fortescue, who also cautioned against the acceptance as a true lightning wave one that had been chopped by flashover at an insulator. He was not ready to agree that, as a general principle, the presence of ground wires reduces the attentuation of the traveling waves. Some skepticism was also expressed by him about magnitude of tower leg current.



Pretty, but distressing to the engineer

Statistical support for the efficacy of ground wires was presented by F. E. Andrews, whose lines experienced 66 outages per 100 miles per year on three 132-kv. lines without ground wires, but on which the outages dropped to one per 100 miles per year after installing ground wires. Further advocacy of meteorological and statistical outage studies was urged by E. J. Amberg; the path and time of storms if known would assist materially in determining which lines could most economically be rendered essentially proof against lightning. More precise knowledge about the physical characteristics of lines and structures is also needed; for example, C. A. Jordan stated that it was important to establish the ratio of tower impedances for the steady state and transient conditions. He also called attention to the fact that the conclusions about the coupling effect of multiple ground wires as derived from the Stillwater and Croton tests are contradictory.

The doubt about precision of stroke

recorder indications was admitted by J. J. Torok, but he gave assurance that the inductive drop was the greater factor in establishing the potential across the recorder terminals. He advocated connecting the ground end of the recorder to the ground some distance away from the tower in future installations. It was not his belief that grading shields affected the impulse flashover any more than to prevent the arc striking into the insulator string. J. H. Cox cautioned against too literal an interpretation of klydonograph and cathode-ray oscillograph records; one of the jobs of the immediate future is to improve the precision of indication of the initiating moment and assure the inclusion of all the rising front of the wave. That the tower surge impedance is about twice the meggered ohmic value, but that the ground impedance to surge may actually be less than the d.c. value, was surmised by C. L. Fortescue, with the consequence that the composite value may be either less or greater than the meggered value, depending upon the proportions of tower and ground contribution.

Papers at Lightning Session

Cathode-Ray Oscillograph Studies of Lightning on Transmission Lines, J. H. Cox and Edward Beck, *Westinghouse Electric & Manufacturing Company*

Surge Characteristics of Insulators and Gaps, J. J. Torok, *Westinghouse Electric & Manufacturing Company*

Lightning Voltages on Transmission Lines, R. H. George, *Purdue University and* J. R. Eaton, *Consumers Power Company*

Study of Traveling Waves on Transmission Lines with Artificial Lightning Surges, K. B. McEachron and W. J. Rudge, *General Electric Company, and* J. G. Hemstreet, *Consumers Power Company*

Lightning Investigation on 220-Kv. System of Pennsylvania Power & Light Company, Nicholas N. Smeloff, *Pennsylvania Power & Light Company and* A. L. Price, *General Electric Company*

Lightning Investigation on Ohio Power Company System, Philip Sporn, *American Gas & Electric Company, and* W. L. Lloyd, Jr., *General Electric Company*

Lightning Investigation on Transmission Lines, W. W. Lewis and C. M. Foust, *General Electric Company*

Lightning Laboratory at Stillwater, R. N. Conwell, *Public Service Electric & Gas Company, and* C. L. Fortescue, *Westinghouse Electric & Manufacturing Company*

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Corona and Breakdown

Analyses of dielectric breakdown, ionization of paper insulation and corona to ascertain factors that influence these phenomena

EXISTING knowledge of the nature of dielectric breakdown and other characteristics was supplemented at the "dielectrics" session by five papers which involved further research on air, insulating oils, mica, various glasses and impregnated cloth and paper. While the new information on these specific materials, particularly oil, insulated cable and air is interesting in itself, interest was chiefly displayed in the fundamental facts disclosed regarding behavior of dielectrics in general and the ingenious methods of obtaining accurate results.

For example, the studies by Dr. J. B. Whitehead and R. H. Marvin of charging currents in high-grade oils during the first few hundredths of a second after the first application of a continuous voltage indicated the existence of space charges and helped to explain the discrepancies between d.c. and a.c. loss measurements. Typical dielectric absorption curves were found in some cases. In others striking differences and peculiarities were observed. Under continuous potential the oils showed a non-uniform potential gradient due to space charges. One of the outstanding results of the work is the wide difference in the properties of two oils, supposedly the same, and typical of the best grade of insulating oils used in the industry.

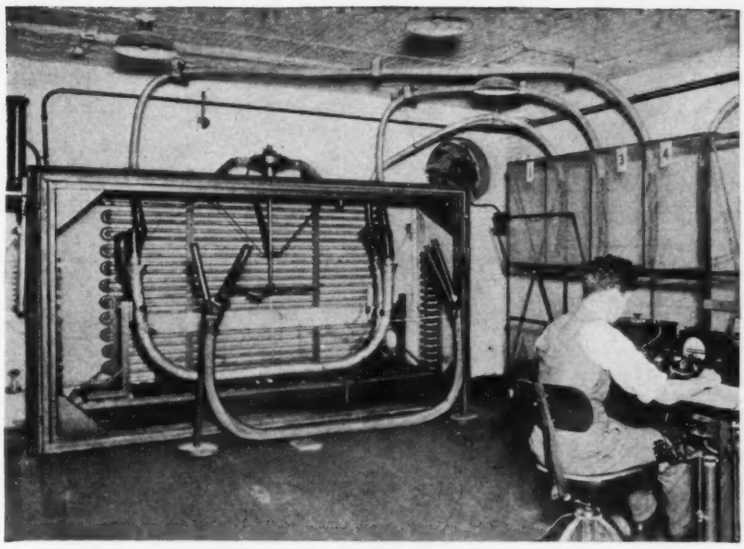
The major portion of the losses in solid dielectrics at low frequencies can be accounted for by the a.c. anomalous charging current, computed from the d.c. functions in the manner prescribed by R. R. Benedict, according to his claim. He contends that the existence of a single kind of dipole would not be sufficient to account for the observed results.

Three distinct types of breakdown are claimed for various kinds of glass by P. H. Moon and A. S. Norcross —(1) disruptive zone, (2) thermal zone and (3) an intermediate zone. According to the authors' curves there is a distinct abrupt change from each zone to the next. A formula for breakdown voltage is given involving thickness of sample, absolute temperature and constants depending on these two conditions. In the intermediate zone the breakdown voltage varies approximately as the $\frac{2}{3}$ power of the thickness and exponentially as the reciprocal of the absolute temperature. The disruptive breakdown value appears to be largely dependent on the SiO_2 content of the glass, and the thermal breakdown on the total alkali content.

The total power dissipated in impregnated paper insulation may be separated by graphical or analytical methods into the components dissipated in the solid and in the ionized gas film, C. L. Dawes and P. H. Humphries demonstrated. While the ionization power curve should be a straight line, it is frequently concave upward due to longitudinal and tangential stresses, according to observations. The maximum power factor and the voltage at which it occurs are simple functions of the cable constants. It is shown that the general shape of the power-factor curve is due to the combination of an invariable solid dielectric in series with ionized gas films whose characteristics vary with current density.

Effects of varying the limits of travel of space charges liberated by a.c. corona on the characteristics of corona were presented by S. K. Waldorf, particular attention being given to corona wave form, current and loss. The values of corona loss obtained differ appreciably from those predicted by Holm, but in general follow the quadratic relation suggested by Peek.

The reported existence of space charges in oils and dielectrics and their effects on a.c. characteristics were confirmed by Dr. W. B. Kouwenhoven. While he maintained that accurate measurements cannot be obtained by using the bridge employed by Mr. Benedict without careful shielding and guarding, R. W. Atkinson contended that the need for these



Fully controlled cable tests remove uncertainties

precautions depends on the accuracy desired.

Prevention of edge-effects, which were so ingeniously minimized by Messrs. Moon and Norcross, was discussed by M. C. Porter, who maintained that spherical specimens will not suffice because they do not necessarily conform with the equipotential contour unless the electrode is specially designed. Preference was expressed for flat specimens tested with electrodes immersed in a semi-conducting solution or with distributed-potential electrodes, one type of which was described. F. M. Clark pointed out that the thickness-strength ratio is affected by the diameter of the electrode used and suggested shielded electrodes as one alternative in test procedure.

The suggestion that there are three distinct zones of breakdown also provoked considerable comment, but two speakers questioned the abruptness of change in breakdown characteristics on which the three-zone conception was based. H. H. Race raised the question whether a curve, rather than a broken line, would not represent conditions more accurately, in which case it would appear that breakdown is a combined disruptive thermal phenomena. Dr. Whitehead reminded his audience that abrupt changes are not common to nature and suggested further study of conditions corresponding to the breaks in the lines. Under the conditions obtaining in practice pyro-electric breakdown is generally the chief cause of failure, Mr. Atkinson pointed out, but that does not indicate it is the sole cause of failures in dielectrics.

Some conclusions by Messrs. Dawes and Humphries were attacked by T. F. Peterson because they were based on very limited conditions that would not apply to the whole range of investigation. As a substitute Mr. Peterson submitted a formula which he declared does apply quite accurately over a wide range.

The possibility of obtaining a visual picture of the motion of charged particles in oil from convection currents was suggested by Mr. Race, and Dr. Whitehead referred to a method of measuring quantitatively the physical force exerted by corona streams.

Commenting on the monetary value of research, D. W. Roper pointed out that just one piece of research to determine the permissible operating temperature of cable cost $18,000, but it increased the value of cable in the 25 to 35-kv. class alone $70,000 in a short period.

The great gap that exists between the work of pure scientists and dielectricians, as Prof. V. Karapetoff termed engineers, is depriving industry of many benefits which could come from closer co-ordinated work of the two groups. He made a plea for establishment of more channels of intercourse and co-operation between these two groups. Unless this is done, he declared, progress will be nearly as futile as if engineers now refused to accept any new ideas evolved since 1910.

Papers at Dielectrics Session

Conductivity of Insulating Oils, J. B. WHITEHEAD and R. H. MARVIN, *Johns Hopkins University*

Behavior of Dielectrics, R. R. BENEDICT, *University of Wisconsin*

Three Regions of Dielectric Breakdown, P. H. MOON and A. S. NORCROSS, *Massachusetts Institute of Technology*

Ionization Studies in Paper-Insulated Cables ..—III, C. L. DAWES and P. H. HUMPHRIES. *Harvard Engineering School*

High-Voltage Corona in Air, S. K. WALDORF, *Johns Hopkins University*

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Arc Welding Problems Less Formidable

Calorimetric studies of arcs, relative merits, results of physical tests of weld

A PAINSTAKING attempt to analyze arc-welding phenomena by electronic emission and heat balance and calorimetric methods was the bone of contention at Thursday afternoon's session on welding. Improved applications of electric welding in the manufacture of machinery and the development of automatic welding equipment gave encouragement to engineers interested in heavy-duty uses of this rapidly advancing branch of the electrical art. The consensus of opinion was that although the approach of Doan, Compton and others to arc phenomena interpretation is handicapped by assumptions and scarcity of data, it tends to cut down the number of uncertain factors in analysis and thus lays a foundation for future progress in design and applications.

Hitherto arc welding has made little headway in applications where dynamic stresses were imposed. Information was lacking on the fatigue

resistance characteristics of such welded structures. Recent investigations by Stone, Ritter and others justify a more general use of arc welding under these conditions. Such applications can be successfully made by duly considering maximum working stress, residual welding stresses and stress concentration.

The initial stresses encountered in welded structures have proved very harmful when the structure is subjected to varying stresses. These initial stresses are caused by actual shrinkage of the weld metal and by unequal heating. Bending and twisting strains are set up while cooling to room temperature. In the manufacture of rotors annealing at 1,000 deg. F. has removed practically all initial stresses and has been adopted for all welded apparatus by a leading manufacturer where a strain-free condition is necessary. Annealing at higher temperatures was found undesirable on account of warping and cracking of the welds. Direct-current motors for heavy service require no welded connection between rotor spokes and rims, thus permitting welding without strain annealing. Diesel engine-driven generators and other drives have been tested under repeated short circuits and at maximum speed and are designed by one maker to withstand a torque load of ten times normal. Arc-welded brackets for supporting waterwheel generator rotors of as high as 25,000-kva. rating are now being sucessfully welded electrically.

As a competitor of other methods of welding steel sheets the carbon arc is making much headway. It eliminates beveling sheet edges in melting through plates even $\frac{1}{4}$ in. or $\frac{3}{8}$ in. thick. Motor-driven welding heads are coming into wider use, simplifying field operations and so cutting costs. Arc stabilization by the use of the magnetic field is a step toward better control. The field also aids in rotating ferrous material to be welded, improving the mixture. J. C. Lincoln expects that in five years only 5 per cent added "fill-in" material will be required to insure greater strength in the weld than in the parent metal, contrasted with about 20 per cent today.

Resistance welding continues to develop in usefulness, notably along the line of flash butt welding. In this type of application the main object is to combine the maximum degree of acceleration of the metals into the flashing zone with the proper voltage conditions. Despite its low electrical efficiency (sometimes 7 per cent or less) butt welding competes with other methods when applied to problems of mass production on account of its cheapness, speed and reliability. A typical power-driven flash pipe butt welder, according to B. T. Mottinger, will weld a 12-in. standard gas or oil line pipe in seven seconds consuming 2.7 kw.-hr. It will produce 40 complete welds per hour and, despite the fact that it requires five men to operate it, represents the cheapest and most efficient means yet devised for welding together lengths of pipe. In butt welding generally the short duration of the peak load in the cycle minimizes the objections formerly leveled against the method from the power-factor and peak-load standpoints.

Papers at Arc Welding Session

Cathode Energy of the Iron Arc, G. E. DOAN, *Lehigh University*

Calorimetric Study of the Arc, P. P. ALEXANDER, *General Electric Company*

Resistance Welding, B. T. MOTTINGER, *Federal Machine & Welder Company*

Electrically Welded Structures under Dynamic Stress, MORRISS STONE and J. G. RITTER, *Westinghouse Electric & Manufacturing Company*

Welding with the Carbon Arc, J. C. LINCOLN, *Lincoln Electric Company*

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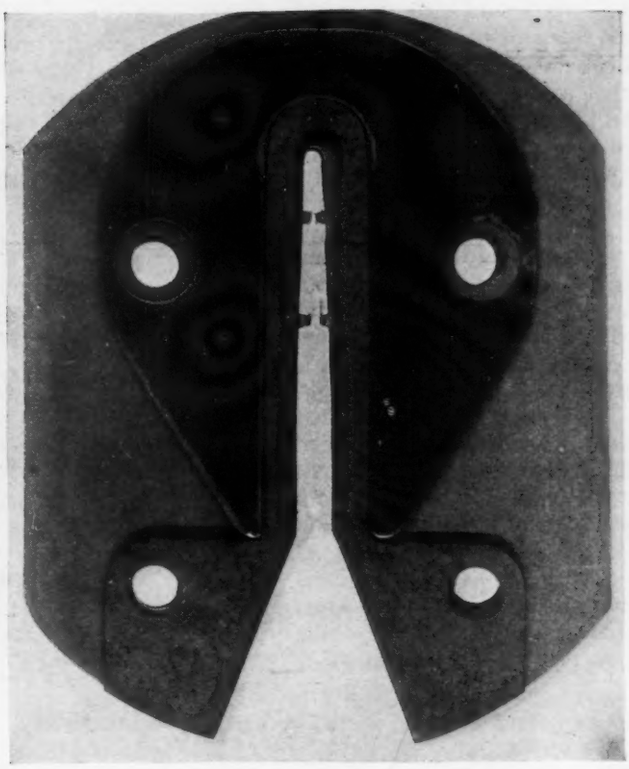
Equipment Protection

Metal-clad switchgear, auto-valve and thyrite arresters, expediting rupture of arcs

BETTER lightning arresters whose performance characteristics under most conditions may be accurately foretold; startling improvements in oil circuit breakers, with promise of less violent action and greatly reduced oil maintenance, and extension of the metal-clad switchgear principle in outdoor substations without cost disadvantage were the outstanding encouragements for the electrical engineer who attended the session on protective devices at the A.I.E.E. convention.

Thyrite, unrevealingly described as "having mechanical properties somewhat similar to those of dry process porcelain, but possessing the remarkable property of being substantially an insulator at one potential and a good conductor at certain higher potentials," is the latest contribution of the General Electric Company to improved line protection. Thyrite in the form of disks, 6 in. in diameter and $\frac{3}{4}$ in. thick or 3 in. in diameter by 1 in. thick, is assembled as required in self-contained units which do not require a series gap. This material does not follow Ohm's law, for each time the voltage is doubled the current increases 12.6 times. The ratio of change of current to change in voltage is constant over ranges of current of 10,000,000 to one. Claimed advantages include: Ample protection for all insulation, conservative factor of safety from failure, permanence, small size and weight, low installation cost, invariable characteristics and predicable results for any given condition and characteristics which can be measured by the user. Three types, station, distribution and high-voltage transmission, are available. No claim for great efficacy under direct strokes is made, but induced charges are hopefully regarded as solved by the sponsors.

Improved auto-valve arresters which, applicable to high-tension duty, may be suspended below the insulators on tower line construction without overburdening the design, yet offering new possibilities in line protection, were described by Westinghouse Electric & Manufacturing Company engineers. The arrester, as applied, is so designed that the cut-off voltage is close to the crest of the arrester's voltage rating so that only a small current is permitted to flow through the arrester following a lightning discharge. This small leakage current is interrupted by a series gap. The new automatic arrester elements are of such small



DEION GRIDS IMPROVE OIL BREAKER PERFORMANCE

Iron, fiber and fullerboard are used in building up the grids on the stationary contacts. Narrow, constricted channel for oil control permits gas suppression of the arc drawn in the vertical opening.

size that a block 1 in. thick is good for a rating of 3,000 volts r.m.s. This has made possible arresters of greatly reduced over-all dimensions and at the same time is said to have involved performance improvements rendering application to high-tension transmission lines entirely practicable. More than 2,500 arrester years of service experience with the old type of autovalve equipment led to the derivation of this new and improved form.

Whatever else may be the merits in the present lightning arrester situation the two largest electrical manufacturers appear to have agreed substantially on a voltage ratio of 2.5 to 2.8.

"Nothing in the lightning studies to be reported upon later in this convention appears to justify lightning arresters," said Philip Sporn, American Gas & Electric Company, "but we continue to use them. More experimental work is needed. Present developments should make the rationalization of design and insulation easier than before."

Oil circuit breakers of the conventional type may be rebuilt for vastly improved performance and minimized maintenance work by the substitution of Deion grids for the customary stationary contacts and the introduction of lighter moving contacts and supports. Putting the gas formed by the decomposition of the oil by the arc to work, as described on page 249 of the February 1 issue of ELECTRICAL WORLD, is the latest advance in circuit breaker design. Test data obtained by several users indicate that the hopeful anticipations of Westinghouse engineers are being realized. Transmission line applications are foreseen as deriving greatest benefits from this development.

Tests of Deion grid breakers by the Duquesne Light, Alabama Power and Philadelphia Electric companies, made too recently to be concluded in the formal presentation, were reported upon. "This type of breaker," in the opinion offered on behalf of E. C. Stone, Duquesne Light Company, "goes a long way toward solving the problem of multiple operation without frequent maintenance." Over-duties of 115-200 per cent have not proved too burdensome for rebuilt equipment of standard design. Allied investigations by General Electric engineers, mentioned by R. M. Spurck of that organization, of the vacuum breaker indicate higher theoretical efficiency for this type than for the Deion grid unit. In the opinion of Dr. Slepian, Westinghouse Electric & Manufacturing Company, practical reliability offsets admitted potentialities in circuit breaker design.

As the result of the investigation of the basic phenomena of circuit interruption by J. Slepian the Deion grid was developed. The fundamentals established in this study are likewise reported upon in the February 1 issue of ELECTRICAL WORLD. Principles formerly but partially formulated were summed up by Dr. Slepian, as was his concept of interrupting devices. "The oil circuit breaker is a gas blast switch, the gas blast arising from the decomposing oil. The efficiency of rupturing performance is directly proportional to the effectiveness of the means for preventing the escape of gases generated in the vicinity of the arc without passing through the arc stream."

Metal-clad switchgear is about to achieve a measure of well-deserved popularity if the formal presentation of State Line station adaptations by A. M. Rossman and the corroboratory comments of others who spoke at this session can be accepted whole-

heartedly. Maximum safety to operating and maintenance personnel at reduced cost, with the repeated anticipation that mass production and less fussiness by specifying engineers in their insistence upon unnecessary and costly changes will yield further savings in price to the user was intimated. Studies of probable costs by the Commonwealth Edison Company have precluded generalizations for metropolitan areas, but the value of simpler layouts and the economies possible were definitely established; the custom-made trend must be avoided. One large user found that the safety and economy anticipated may only be secured in large switching centers with double bus construction. Savings there ran about 10 per cent.

The reiterated view by several commenters that outdoor switch yards, particularly circuit breaking equipment, proved safer than indoor designs was contested by Philip Sporn, who referred to "at least one large system where indoor design was esteemed safer." A possible difficulty with metal-clad gear was sensed in the reduced flexibility when in operating emergencies one line takes the place of two.

Papers at Protective Devices Session

Metal-Clad Switchgear at State Line Station, A. M. ROSSMAN, *Sargent & Lundy, Inc.*

Development of the New Autovalve Arrester, J. SLEPIAN, R. TANBERG and C. E. KRAUSE, *Westinghouse Electric & Manufacturing Company*

Thyrite, a New Material for Lightning Arresters. K. B. MCEACHRON, *General Electric Company*

Extinction of a Long A.-C. Arc, J. SLEPIAN, *Westinghouse Electric & Manufacturing Company*

Use of Oil in Arc Rupturing with Special Reference to System Stability, B. P. BAKER and H. M. WILCOX, *Westinghouse Electric & Manufacturing Company*

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Simulating Sunlight

Consolidation of therapeutic and optical properties of sunlight in incandescent bulb accomplished

THE Illuminating Engineering Society met jointly with the A.I.E.E. on Monday evening to hear two papers on the development and measurement of simulated sunlight. Dr. Luckiesh, director research laboratory, National Lamp Works, held out the prospect of providing the electric lamp with all of the health-giving and health-restoring properties of midsummer sunlight in his presentation of the story of the new sunlight lamp.

The most important detail in the production of artificial sunlight is the short-wave cut-off of the spectrum. Ideally, this should be in the neighborhood of λ 2900, because no energy of shorter wave length reaches the earth from the sun. The upper atmosphere is responsible for this restriction. Apparently, through the formation of ozone, the radiation of shorter wave lengths is absorbed. Practically, the short-wave cut-off for an artificial sunlight can extend somewhat further into the ultra violet. The limiting factor is the production of conjunctivitis.

The next point of primary interest is the relative importance of the distribution of energy throughout the spectrum. There is plenty of evidence that a line-spectrum, such as that of the mercury arc with energy of many wave lengths absent entirely, produces results similar to that of outdoor sunlight. Furthermore, photochemical reactions are produced usually over a range of wave lengths and not by a single wave length. Therefore, it does not appear necessary to reproduce the solar spectrum wave length for wave length.

The first new practical source for simulating sunlight which has been developed with this possible new era in mind is a tungsten-mercury arc known as the sunlight (type S-1) lamp. A tungsten filament operates in parallel with a mercury arc between tungsten electrodes. The hot filament near a pool of mercury vaporizes the latter and the arc is completed almost instantly after the switch is on. The bulb consists of a glass with a suitable spectral cut-off. The lamp can be operated throughout a wide range of angles and it has no movable parts. For general use it has the primary requisite—simplicity.

The type S-1 lamp is a low-voltage source and the volt-ampere characteristic of the transformer is important. At present the wattage is approximately 400, but there appear to be no insurmountable obstacles in the way of altering the wattage considerably. The voltages are approximately as follows: No-load, 35 volts; when only filament is operating, 33 volts and 9 amp.; after arc starts, 11 volts and 30 amp. All this operation normally takes place almost instantly after the switch is thrown. The light is whiter than that which would be obtained from melted tungsten. As measured with the eye and an ordinary photometer, the amount of light which is emitted by the various elements is somewhat under the control of the designer. At present, about 68 per cent is emitted by the tungsten electrodes, 25 per cent by the arc and 7 per cent by the filament.

The ultra-violet energy between λ 2800 and λ 3100 is said to be particularly beneficial to health. Therefore, in order to produce an effective substitute for sunlight at reasonable intensities of illumination, relatively much more energy in this region has been provided than that in the solar spectrum.

It is seen that an exact reproduction of the spectrum of sunlight is impracticable so long as popular demand insists upon the same degree of effectiveness from low intensities of artificial sunlight indoors as from high intensities of midsummer sunlight outdoors. This is a very important foundation-stone underlying the production of a sunlight substitute and an understanding of it is equally important.

Dr. H. C. Rentschler, director of research Westinghouse Lamp Company, disclosed a meter capable of registering the intensity and duration of exposures to ultra-violet radiation. Various principles may be and to some extent have been employed in measuring or estimating the intensities—chemical with color index, thermal with temperature index, photometric with fluorescence index. The method employed in the new meter is photo-electric. The photo-electric cell is rendered selectively responsive to the wave lengths of 2800 to 3200 Angstrom units,

which are known to be valuable from the therapeutic standpoint.

A battery charges a condenser at a rate determined by the photo-electric current produced in a cell when light falls upon the cathode of the cell. Heretofore this rate of charging of the condenser, or in some cases the reverse effect, namely, the rate of discharging of the previously charged condenser, was measured by means of an electroscope or electrometer. The simplicity of the scheme described depends upon the substitution of a specially designed glow tube, a "glow relay tube." The light falling on the photo-electric cell charges the condenser to such a potential that a discharge takes place, the cathode resistance of the glow tube is broken down and a current flows between the main anode and the cathode. This operates the relay, pulls the armature over, registers the count and at the same time opens the main circuit. Simultaneously the condenser is discharged. The intensity of the light falling on the photo-electric cell, which is effective in producing photo-electric action, is proportional to the rate at which the counter registers and the total quantity of effective light which has fallen on the cell is proportional to the total number of discharges registered by the counter. In some cases it is desirable to use a sensitive relay, which in turn closes and opens a separate circuit which operates the counter or other recording or operating device. By means of this device it is possible to measure photo-electric currents of the order of a thousandth of a microampere or much less with as great ease as we now measure electron emission currents by the use of millameters.

In the discussion Dr. Goodman disagreed with Dr. Luckiesh on the efficacy of foot-candle meters as indices of the intensity of ultra-violet radiation. It was brought out that the ultra-violet content of the radiation falls off some 40 per cent with 10 volts change in voltage at the terminals, but that the visible portion suffers only 30 per cent. The foot-candle meter is adequate for a given lamp with fixed voltage and fixed proportions of ultra-violet to visible radiation.

Papers at Ultra-Violet Session

Simulating Sunlight, M. LUCKIESH, *National Lamp Works of General Electric Company*

An Ultra-Violet Light Meter, H. C. RENTSCHLER, *Westinghouse Lamp Company*

Long-Range Communication

Methods of solving submarine telegraph, and transoceanic short-wave radio telephone problems

"AT 4 O'CLOCK in New York on a recent Thursday afternoon I telephoned to a man in Sydney, Australia, where it was 6 o'clock on Friday morning," said Bancroft Gheradi, vice-president of the American Telephone & Telegraph Company, at the transoceanic communication session of the A.I.E.E. last Thursday. Construction has begun of a radio telephone station on the West Coast for the purpose of extending telephone facilities to the islands of the Pacific and to Asia. From any place in the United States or Canada it is now possible to connect with 85 per cent of the telephones in the world. Expansion of overseas telephone and telegraph service was the keynote of five papers depicting recent progress in communication engineering and traffic development. Notable improvements in the speed of cable telegraphy and striking gains in the reliability of transatlantic radio telephony have been attained. To developments in the regenerative telegraph repeater, the inductively loaded cable and the utilization of short-wave radio in conjunction with long-wave transmission is due much of the truly spectacular advance in overseas electric communication in the last few years.

The regenerator has cut labor costs at repeater stations about 70 per cent; it has met the challenge of the transoceanic radio for "direct" connections, has improved the speed of service on the bulk of traffic and increased the accuracy of transmission. Higher speeds on all permalloy cables are at present limited only by terminal apparatus. Printers are now successfully operating on high-speed unidirectional cables.

Reliability is a prime factor in the commercial success of any form of electric service. That overseas radio telephony is making real progress in this direction was stressed by Dr. F. B. Jewett in commenting upon the utilization of short and long wave channels to render parallel and supplementary transatlantic service under varied climatic and cosmic disturbances. The new transmitting station at Lawrenceville, N. J., and the receiving station at Netcong, N. J., exhibit interesting applications of directional antenna systems by which the useful power of the carrier is multiplied about fivefold. These stations occupy over 2 square miles of land area and challenge the best abilities to improve their economic and technical status. Evolution is hard at work in this branch of communication engineering.

At Lawrenceville a 1,200-kva. substation is required to furnish power for the diversified needs of the plant. Four transmitters are in use. The directive antennas are supported by 28 steel towers 180 ft. high in a "V" formation. One side is assigned to the channels to England and the other to the projected South American circuit. The radiated frequencies range from 22,000 kc. to 6,500 kc. (13.5 to 45 m.). Separate antennas are used for each operating frequency. At Netcong the receiving antennas are six wave lengths long and the lowest conductors 10 ft. above ground. The transmission lines are built of copper tubes supported a few inches above the earth and erected in a sinuous course to care for expansion and contraction. Sharp turns were avoided on account of reflection disturbances. The end-to-end separation is about four wave lengths. Isolation from air routes and roads carrying heavy traffic was necessary on account of interference from internal combustion engines, and at

Papers at Transoceanic Communication Session

The Post-War Decade in Submarine Telegraphy, I. S. COGGESHALL, *Western Union Telegraph Company*

Transocean Telephone Service — General Aspects, T. G. MILLER, *American Telephone & Telegraph Company*

Transmission Features of Short-Wave Radio Circuits, RALPH BOWN, *American Telephone & Telegraph Company*

Technical Features of the New Short-Wave Radio Station of the Bell System, A. A. OSWALD, *Bell Telephone Laboratories, Inc.*

Plan and Construction of Short-Wave Radio Systems, F. A. COWAN, *American Telephone & Telegraph Company*

Lawrenceville service automobile ignition systems must be shielded to prevent interference in telephonic transmission. The average number of transatlantic calls per day has increased from seven in 1927 to 48 in 1929, with a maximum of 139. Social calls account for 48 per cent, bankers and brokers 27 per cent and merchants 4 per cent.

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Temperature Loading and Phase-Angle Control

Temperature loading of transformers, phase-angle control, tap changing, quiet induction motors, ventilation and torque-angle characteristics of salient-pole machines

"SUBTLE intimations of glories yet to be" colored the final sessions of the convention. Accomplishments, the consummation of which are foreseeable tomorrow, the day after, or next year, crowded more palpable evidence to the background. Quiet induction motors—coming, but not here. When is a motor quiet? Transformer loadings, particularly for large sizes, which permit greater output for a given nameplate rating will probably be agreed upon by standards committees. Preliminary acceptances have been formulated.

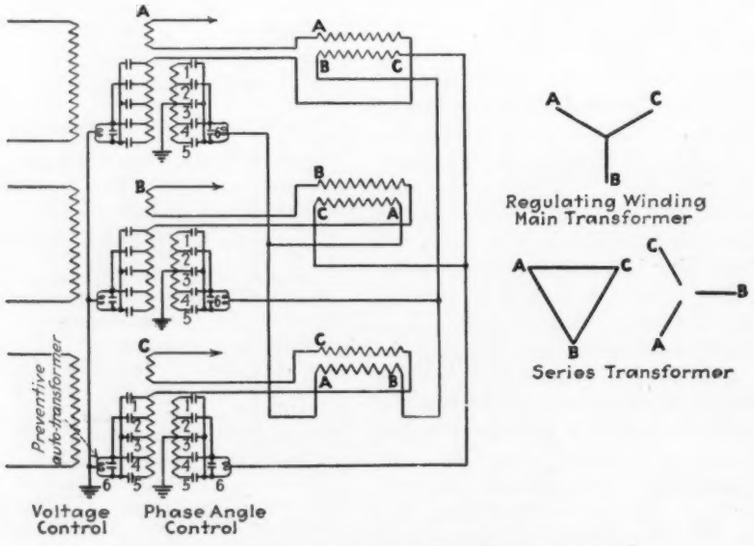
Loading and operation on a temperature basis offering more complete use of facilities already provided is an approaching economy step, but "rating standards" and "recommendations for operation" constitute points of difference at present. "The capacity can be increased 1 per cent for each degree that the ambient is below 25 deg. C. for water-cooled and 30 deg. C. for self-cooled transformers," said V. M. Montsinger.

Improved transformer tap changing under load will lessen system disturbances and improve operating conditions. Double-purpose equipment for phase-angle and power-factor control allow for future system requirements. Flexibility is at a premium. New wiring arrangements offer better performance.

A generalized theory of electrical machinery, based upon a new point of view, omitting analytical quantities such as magnetizing current, armature reaction, leakage flux and transient reactance and including graphically only such quantities as actually exist in the machine at one particular load, was expounded by Gabriel Kron. Stored energy, free energy, work done—the basis. "A new language," remarked Prof. C. A. Adams, "to understand which we must study. As a rule we have had too little generalization. This method gives a better picture of the relationships involved, but does not appear to eliminate the analytical method." The Einstein touch was imparted by the author, who in closing remarked: "In some places I do not understand it myself."

Quieter electrical machinery can and will be obtained, but costs delay development. So long as unnecessary design restrictions and undesirable torque characteristics are not imposed, declared L. E. Hildebrand, a motor will be quieter if the number of poles, stator slots, rotor slots, difference of rotor and stator slots, and the winding repetitions bear simple multiple relationship. The motor is quieter the larger the greatest common devisor of these factors.

A detailed study with adjustable models of revolving-field salient-pole alternators promises better cooling for such equipment. Eleven independent structural variables were introduced and formulated.



Combined phase-angle and voltage control

Papers at Electrical Machinery Session

Loading Transformers by Temperature, V. M. Montsinger, *General Electric Company*

Recommendations for Safe Loading of Transformers by Temperature, W. M. Dann, *Westinghouse Electric & Manufacturing Company.*

Tap Changing Under Load for Voltage and Phase-Angle Control, H. B. West, *Westinghouse Electric & Manufacturing Company*

Telephone Interference from A-C Generators Feeding Directly on Line with Neutral Grounded, J. J. Smith, *General Electric Company*

Inversion Currents and Voltages in Auto-Transformers, A. Boyajian, *General Electric Company*

Generalized Theory of Electrical Machinery, Gabriel Kron, *Lincoln Electric Company*

Quiet Induction Motors, L. E. Hildebrand, *General Electric Company*

Transient Torque-Angle Characteristics of Synchronous Machines, W. V. Lyon and H. E. Edgerton, *Massachusetts Institute of Technology*

Starting Performance of Salient-Pole Synchronous Machines, T. M. Linville, *General Electric Company*

Ventilation of Revolving-Field Salient-Pole Alternators, C. J. Fechheimer, *Westinghouse Electric & Manufacturing Company*

Synchronous Machines, V, (Three-Phase Short Circuit), R. E. Doherty and C. A. Nickle, *General Electric Company*

A.C. vs. D.C. Solenoids for Industrial Control

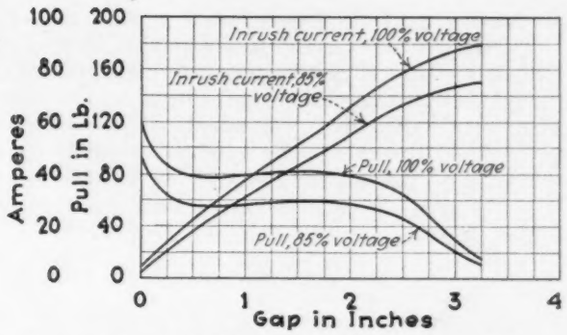
By H. R. CRAGO
Industrial Control Department,
General Electric Company

THE choice of control apparatus in industrial applications depends primarily upon which type of service is available, alternating or direct. In some cases, however, the relative properties and limitations of d.c. and a.c. solenoids for actuating the control apparatus may be of importance second only to that of the corresponding characteristics of the motors which they control.

Due to simplicity and strength, the alternating-current solenoid finds a wide field of use where a simple pull or thrust motion is desired, where quick action is necessary, or where the complication of cams, etc., to transform the rotary motion of a motor is undesirable.

The alternating-current solenoid has inertia comparable in proportion to that of a motor and, therefore, when the plunger is started there is nothing to retard it except the load. Under given stroke and voltage conditions the amount of work which the solenoid will deliver is fixed, and this amount of work will be delivered either to the load or as a hammer blow to the frame. It is apparent, therefore, that an underloaded solenoid, especially in the large sizes, will soon destroy itself.

Another characteristic of an alternating-current solenoid is its inherent high inrush current. This inrush may reach values of fifteen to twenty times the magnetizing current when operating at full stroke. To arrive at a fair approximation of the inrush on any well-designed alternating-current solenoid, a value of 100 to 125 volt-amperes per inch/pound of work can be used for a 60-cycle circuit. This value decreases in approximately direct proportion with the frequency. It is apparent from the above, therefore, that for a relatively small amount of work the momentary power requirements are very high. For example, if it is desired to pull 50 lb. through a stroke of two inches the inrush at 60 cycles is approximately 12.5 kva. It is also apparent from the above that the application of alternating current solenoids to a rapid duty cycle is not permissible, since the inrush current period is then a large proportion of the total time cycle causing excessive heating on the solenoid. In a rapid duty cycle application the time during which the inrush current is effective can be reduced somewhat by decreasing the load on the solenoid, thus speeding up the plunger stroke. This method, however, as previously explained, should be discouraged on large solenoids, because of the excessive hammer-blow action on the solenoid frame.

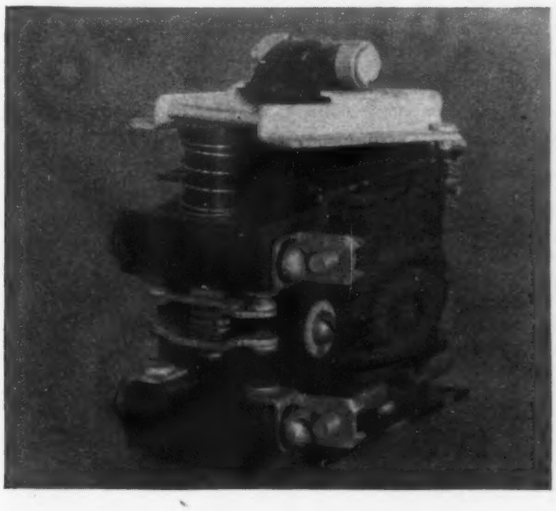


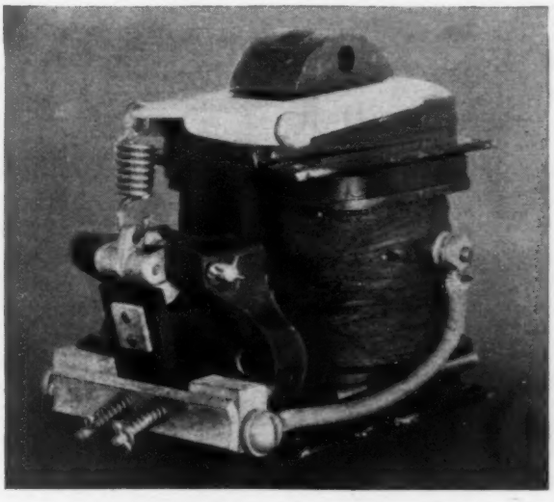
A.c. solenoid characteristics are good for simple pulls or pushes

Because of the high inrush currents it is of importance in solenoid application to insure against excessive voltage drop in supply lines by using lines of current-carrying capacity based on the inrush current rather than on the magnetizing current. Since the pull of an alternating-current solenoid decreases as the square of the applied voltage, the voltage drop in the supply lines is reflected in the solenoid performance.

To promote interchangeability and standardization upon a reduced number of styles, it has been necessary to adapt alternating-current solenoids to operation on direct current. Since on direct current the high inrush current is

TWO MODERN SOLENOIDS USED ON MANY APPLICATIONS





not available to perform the necessary work, it is necessary so to design the solenoid to obtain this correspondingly high number of ampere turns by another method. This is generally accomplished by using a cut-out switch operated from the final movement of the solenoid plunger. This cut-out switch, which is normally closed on solenoids of the shunt type, may be used either to insert an external resistor in series with the operating coil after the solenoid has done its work or to insert a high-resistance section of the operating coil in the circuit.

The application of direct-current solenoids of the cut-out switch type is objectionable for rapid duty cycles first, because of the large part of the total time during which the inrush current is effective and, second, because of the excessive duty on the arcing and mechanical parts of the cut-out switch. In many cases where solenoids of this type have been applied it has been found practicable to use the auxiliary control devices, such as drum switches, time delay relays, etc., to insert the high-resistance winding or external resistor.

It has been pointed out that in the alternating-current solenoid there is nothing except the load to prevent high-speed operation. This is not the case in a direct-current solenoid, since the movement of the plunger generates counter-emf. which tends to decrease the current and therefore the speed of the solenoid. This effect, however, is a function of the inductance, which, in turn, is a function of the saturation of the iron used in the solenoid. The eddy currents induced in the iron circuit or in other short-circuited metallic parts will also reduce the speed of operation. Since in the use of an alternating-current solenoid with cut-out switch the frame is laminated, there is practically no retardation due to eddy currents; also, since the iron is saturated almost to the limit, and therefore has a very low inductance during the pick-up period, the speed of a direct-current solenoid of this type is practically equivalent to that of an alternating-current solenoid.

In the application of alternating- and direct-current solenoids having cut-out switches provision must be made to permit the plunger to seal. If this is not done the inrush current is maintained and the coil will burn out in a relatively short time. If there is any doubt as to whether the solenoid will seal, an elastic link should be used between the load and the plunger.

In many applications, such as clutches, etc., a dashpot is attached to the load to prevent excessive wear on equipment. When this is done due consideration should be given to the length of time of the inrush period on the solenoid. It is always advisable in such cases to use a spring or equivalent between the solenoid plunger and the load so that the solenoid can close immediately, permitting the dashpot action to be obtained through the spring member.

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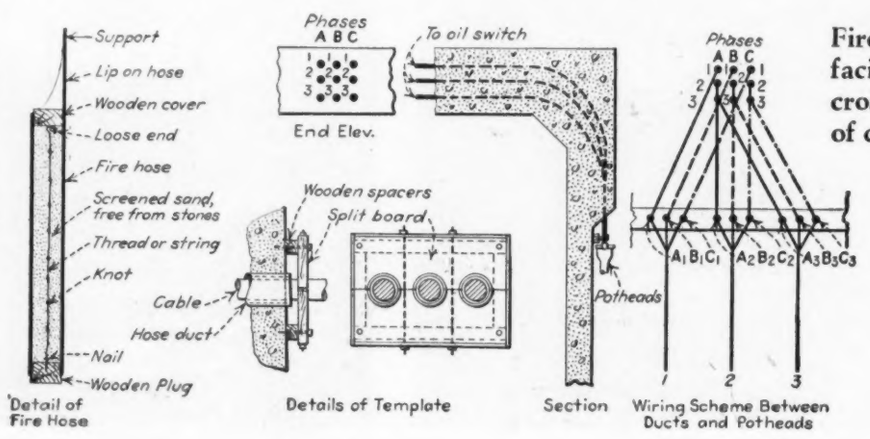
Duct Problem Solved With Fire Hose

IN MAKING connections between the terminals of a 6,600-volt oil switch and the potheads at the end of an underground conduit run space limitations created a troublesome problem. It was necessary to find a simple means of installing flexible ducts concealed in a concrete structure and to provide easy pulling conditions for three-conductor varnished-cambric, lead-covered cables of 700,000- and 1,000,000-circ.mil cross-section. The connections were rendered more difficult by a necessary change in cable grouping, those at the oil switch terminals being in rows of three per phase, while the arrangement of pothead terminals required a grouping of three phases per pothead. The use of fiber duct was out of the question on account of the number of crossings involving sharp bends, as indicated in the accompanying illustration. Neither was it practicable to install non-magnetic metal conduit on account of the resistance offered to the pulling of large cables and which would also involve considerable expense. Flexible conduit was not feasible due to the size of the cables and the need of running this duct concealed in concrete.

A simple and economical method was found by making use of a quantity of 3½-in. fire hose filled with sand, which was placed in the forms to provide the proper connections. For convenience in filling, the top was cut with a supporting lip. The bottom was sealed with a wooden plug, having a nail driven into it for attaching to it a knotted string with the loose end coiled under a wooden plug at the top of the hose. After the concrete was set, the plugs were loosened and the string agitated in the duct to free it of sand. These ducts were kept properly spaced at the oil switch and pothead terminals by templates of split boards bolted together and provided with wooden spacer strips between the concrete and the template to insure free breathing of the ducts.



Fire hose carriers facilitate cross-connecting of cables

ENGINEERS and FINANCE

By C. E. GROESBECK*

President Electric Bond & Share Company

THIS ARTICLE is a clear exposition of modern industrial and financial conditions. It voices the conviction of executives that engineers are open to larger and larger opportunities and responsibilities. It gives food for thought to all educators, industrial leaders and engineers.

THE industrial revolution of the last century, achieved in large part through the labors of engineers, compelled the world to change from the hand-to-mouth methods of an earlier day and brought the forces of finance and of engineering into closer touch.

Here in the United States a new political economy was evolved, with mass production, low prices and high wages as its cardinal principles. The successful application of these new ideas required the integration of industry into larger units, with financial resources sufficient to provide the necessary plant and equipment, and with executives fitted, by training and experience, for their special responsibilities.

In the light of these conditions, it was inevitable that men with an engineering background should be sought out by the financier before he risked his funds in unfamiliar enterprises.

Thus at the very outset of the new industrial era the engineer found a new field for effort.

Essentially the fundamental function of the engineer is the assembling and integration into a useful structure of the unorganized and loosely distributed material and forces of nature. Similarly the essential function of the financier is to gather and integrate the unorganized and scattered financial forces of society into organic structures which will perform socially useful work.

There is undoubtedly a widespread impression that a few rich people or institutions are able and willing to provide the hundreds of millions of capital required for the building of our railroads and utilities, our factories and other projects which meet the demands of a growing population and of advancing living standards.

The electric light and power utilities alone plan to spend during the year 1930 nearly one billion dollars for new construction. Of course, no man or small group of men can provide this enormous sum of money. If it were in any way possible for such a man or group to do so, such action would result in the wholesale diversion of existing capital from one industry to another and the consequent necessity of refinancing the first industry from the general public.

It is difficult to estimate even approximately the number of people who will share in providing this billion dollars needed by the electric public utilities this year. I would hazard the guess, based upon my knowledge of the distribution of utility securities, that more than a million of our citizens will participate in supplying this capital.

While it was formerly necessary for us to go abroad for a large portion of our capital, the recent war and

*Presented before the Michigan Engineering Society, Ann Arbor, Mich., January 30, 1930.

ALL FORMS of transportation, including shipping, railroads, street cars, subways, motors, airplanes; structures of all kinds, including bridges and skyscrapers; communication systems, embracing telephone, telegraph and radio; basic industries such as that of electric power production, bringing lighting, heating, refrigeration in its train; in fact, practically every form of modern endeavor that supplies the comforts, conveniences and necessities of modern life owes its development and successful operation, if not its very inception, to members of the engineering profession.

the economic changes which have followed it, coupled with the financial education our people received during the war in the Liberty Loan and similar drives, have required and permitted us to finance our own business undertakings.

Capital waiting employment is subject to the law of supply and demand and is bought in the market at fluctuating rates as are other commodities. Finance furnishes the mechanism for balance and control between the various components of our industrial organization and between industry and other elements of our economic life.

I use the word "control" with some hesitation. I am well aware that to some extent there exists a popular conception, possibly in part spontaneous, possibly in part deliberately fostered, that Finance (with a capital F) is endeavoring to exercise personal control over everything upon which it can lay its hands. Rarely has a popular conception been so misguided. *Finance is the servant of industry, not its master, just as over a far longer period it has been the handmaiden of Commerce.*

Nevertheless, it is through the medium of finance that economic control does function—checking overdevelopment at one place or at one time, correcting underdevelopment at another place or time, fostering new enterprises for which there is economic need, developing new resources—all to a considerable extent balanced and controlled through finance. Current balance is maintained largely through control of credit, long-range balance, largely through direction of investment. But this control is not of a personal nature; its source lies in economic laws as definite as those of mechanics.

The engineer needed

The engineer can, and in some form must, in any sound undertaking bring his direct engineering experience to the aid of the financier or banker who assembles this capital. The banker must either himself have the training and experience which will enable him to judge of the soundness of the project to be financed or he must rely upon the judgment of some engineer in whom he has confidence. While the engineer-financier, if he has departed from the strict technical practice of his profession, will not attempt to pass upon the technical details of the project, yet it is indeed fortunate if he has the training and experience through which he can corroborate the engineer's specialized judgment by his own practical experience.

The engineering training, or habit of mind induced by such training, and intellectual integrity or loyalty to true engineering principles must lead to the approval only of that which is sound and practical, in not only the structural and economic aspects of the undertaking, but in the financial plan which is utilized to secure the capital. The engineer-executive, or the executive advised by a competent engineer consultant, will carry to the financial problem the same standards which in engineering practice are applied to physical structures. He will have in mind the stresses and strains to which the financial structure will be subject and the safety factors which must be allowed to compensate for them. Selfishly he knows that as the failure of a physical structure designed by him would condemn him as an engineer, so the failure of a financial structure which he sponsors will destroy his reputation as a financier. But, beyond this, if well-grounded in the principles of the engineering profession, it would be morally as impossible for him to sponsor an unsound financial scheme as it would have been for him to sponsor an unsound physical structure.

When the banker, with the engineer's assistance, has decided to embark upon the financing of an industrial project, of any magnitude, he faces the necessity of distributing its securities among the investing public. This is done through his salesmen, through branch offices, through investment departments of banks and through various other agencies.

Only in exceptional cases will the promoters of such a project have either the ability or the facilities to gather together in small sums from the four corners of the country the aggregate amount required.

This is the function and responsibility of the banker, and in so doing he is, at the same time, rendering a valuable service to the large body of small investors of the country in thus providing an outlet for their savings.

Responsibility is fixed

If through unsound engineering or faulty financial structure expected earnings are not realized or capital is jeopardized, not only will the banker's prestige and reputation suffer, but, and this is of far greater significance, the real hardship will be borne by the many small capitalists who have invested their hard-earned savings in the project on the recommendation of the engineers and bankers.

Charged with this tremendous responsibility, the banker, to an ever-increasing degree, has called the

engineer into his counsels. He has placed upon the shoulders of the engineer the responsibility for passing upon the feasibility of new projects and of examining and supervising the operations of existing enterprises in which he and his investing clients are so vitally interested.

The engineer may leave the strict practice of his profession to become an officer of a financial institution or of an engineering corporation performing engineering services for banks or investment houses. He may be called to an executive post, supervising the extensions or expenditures of large industrial enterprises, or be commissioned by some expanding industry to negotiate investments in new fields. But he must carry his engineering training and experience into any of these occupations, and in addition must acquire a real comprehension of the processes and the necessities of modern business.

Every well-trained engineer, under the strict discipline of his technical schooling, has acquired certain habits of thought which, once truly attained, he can always apply. It makes no difference into what field of human endeavor he may go, these characteristics are among his greatest assets. He will have acquired power of concentration, power to apply methods of analysis, ability to evaluate the essential and the unimportant, and facility in the correlation of facts.

Of greater importance than these, he has learned to search for the truth and, with infinite pains, to sift truth from error until he has bared the facts. He will respect these truths once found and honestly accept them. Upon this basis, he will plan his courses of action, confident that they will stand the rigorous test to which a practical business world will subject them.

Field of engineering

The engineering field today may be divided into two major classifications—first, that of research or pure science and, second, that which may be termed practical engineering or engineering which concerns itself with planning, designing, building and operation.

Comparatively few of the total number of students in engineering colleges find their life work in the field of research or pure science. These men are in a class by themselves. They are searchers for the fundamental laws of nature and for new resources and concepts which may be brought to serve mankind. They make this search without thought of immediate practical application and are often little interested in things commercial.

From them come ideas which open the doors to future progress and pave the way for new industries. Their accomplishments form the basis for the work of, what I here term, the practical engineer.

The field of practical engineering is well understood, but I would like to point out a significant change which has occurred in American engineering. There was a time when the practical engineer was required to undertake all of the problems of design, manufacture and construction. This day has passed. With few exceptions, the design of the elements which go into engineering construction is the problem of the manufacturer. Much of the equipment and apparatus used in all industry, which not so many years ago was specially designed for each job, is now standardized.

The function of the supervising engineer, therefore, becomes one of selection and co-ordination of equipment from the manufacturer into a completed whole. Today, instead of engineering projects requiring, as in the past, a wide variety of designs of apparatus and equipment in keeping with the individual views of engineers, increasingly there have come into common use standardized units predicated on the best engineering practice.

This has been one of the most significant factors contributing to the success of American engineering enterprises, and it has had a profound influence on the reduction of costs and the promotion of efficiency. The reduction of costs through standardization has had an important bearing on financing, in that it has made possible the building of projects which would otherwise have been economically impossible.

What we may broadly call the field of finance has a definite place not only for what we may term the executive-engineer but also for the engineer who has made himself an expert or an authority on specific phases of industrial engineering.

For instance, in the electric field, notwithstanding the adoption of standardized units, we have specialists to design the foundations and structures of hydro plants, other specialists in steam, specialists in electrical equipment, specialists in transmission and distribution, who each make their contribution and whose advice must be heeded.

The co-ordinating function

It is apparent that some one must co-ordinate the efforts of these specialized engineers and weld them into a workable whole. The man who does this must have a well-rounded knowledge of engineering principles, but he must consistently avoid overemphasis on any particular phase of engineering which may have once been his special interest. His greatest value will lie in his general familiarity with all engineering and his ability to check and measure the commercial worth of the recommendations that come to him from the specialists under his direction. It is his part to see that the completed enterprises will be fully productive and that they will thus attract, on favorable terms, the necessary capital.

Both finance and industry are constantly looking for men capable of analysis of cause and effect, men trained to secure efficiency and economy in the fullest and

THERE IS no longer a personal classification possible in this country between the capitalist and the laborer. Millions of citizens, both men and women, in all walks of life have become capitalists. Their earnings permit the accumulation of surplus funds in savings accounts and in investments.

IT IS NOT too much to say that in this mechanized world of ours, requiring as it does continual outlays of new capital, engineers are being called upon to assume and justify responsibility for the expenditures which make possible the functioning of the entire industrial system.

broadest sense, men with a point of view conducive to long-range vision of future developments and needs, men with courage to discard the obsolete and to effect fundamental innovations after, but only after, comprehensive analysis. These are needs not merely in connection with the subject with which finance is concerned but in connection with the methods of finance itself.

The situation is not static. Conditions now differ from those of ten years ago, and ten years hence probably even greater differences will have appeared. In industry the importance of production and its processes is becoming increasingly predominant. Increasingly greater proportionate investment is being required. High ratios of fixed capital to annual output, which have long characterized public utilities, are tending to be even higher in that field and are becoming increasingly evident in the manufacturing field. The problems of administration, operation and personnel are of no less vital significance. The increasing magnitude of individual industries results in less intermediate business between individual industrial units, and standardization is tending to simplify such intermediate business itself.

One fact must never be forgotten. This is that the world of finance, while seeking the aid of the trained engineer, is looking for more than engineering knowledge, however profound.

The men called to leadership in business and finance must have far more than technical equipment. They must have an appreciation of the springs of action of men and the power to direct and inspire them. The relations and interactions of men are a thousand times more complex than those of materials.

This is strikingly exemplified among the large engineering and construction concerns of the country. Without proper administration and finance these institutions cannot be successful. It follows that they must have capable business and financial leadership. Many of these posts are now filled by engineers. Where the engineering talent possessed of other requisites is available to fill these positions, they should be so filled. But between a high-grade technical engineer without executive and business ability and a high-grade executive without technical ability the choice of an administrator, even for an engineering or construction organization, should fall to the latter.

Many things have contributed to the growth and prosperity of our country, but on analysis it is hard to avoid the conclusion that one of the greatest contributing causes has been the union of financial and engineering talent in developing the complex and growing industries that have established here the highest standards of living the world has ever known.

Other nations have natural resources as great as ours. Until recent years other countries surpassed us in the extent and magnitude of their financial resources. But in no other country has the union of engineering skill with financial genius resulted in the creation of the conveniences and luxuries which have become commonplace among the people of the United States.

The American engineer and the American financier share a common satisfaction, a satisfaction that comes first of all from the conception and translation into accomplished fact of sound and prosperous business enterprises.

Working together, the engineer and the financier have been able to create the machinery of production and distribution which has permitted the people of this country to assume leadership among the industrial nations of the world. Unless I misread all the signs of the times, the contribution which the engineer has made in the field of finance during the past 50 years is as nothing to the contribution he will be called upon to make during the next half century.

Everywhere the needs of a rapidly growing population are increasing the complexity of modern existence. *The world of tomorrow seems destined to be a world in which the engineer must play an increasingly important part, where leadership must go to those who understand the principles upon which our modern world is based.*

There is no way to judge the future save by the past, and as we view the contributions which the engineer has made to finance and business in the past, we can feel confident that the education, the training and the experience of the American engineer will keep pace with whatever problems the future may have in store, no matter what they may be.

THERE ARE many fields besides that of finance in which the engineer has won recognition and distinction, but I know of none where his particular attributes are of greater value to business and the public than in the supervision and protection of the financial side of our great industrial enterprises.

Improved Timing Tests for Overcurrent Relays

By B. V. VOLGOVSKOY
Assistant Chief Test Engineer
Union Gas & Electric Company, Cincinnati

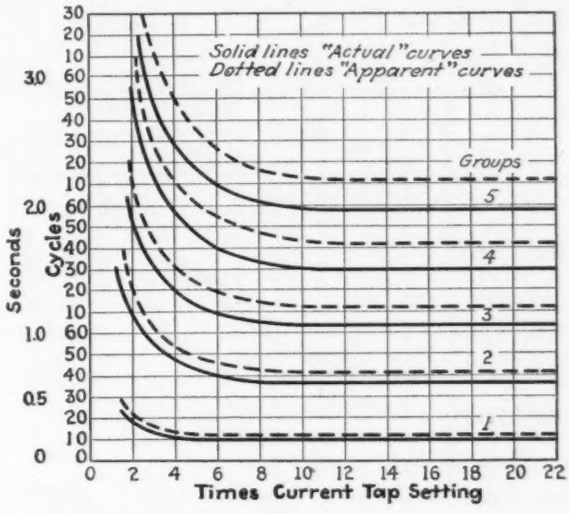
TO SECURE selective tripping of circuit breakers all overcurrent relays on the system of the Union Gas & Electric Company are given one of five standard settings or "groups." These groups are indicated in an accompanying figure for one type of overcurrent relays (solid lines). The groups are spaced equal time intervals apart and are not given any nominal lever settings, but each relay on the system is adjusted until it corresponds to the desired group regardless of the time lever setting.

On a power system with hundreds of overcurrent relays adequate testing facilities must be developed for timing overcurrent relays quickly and accurately, both at the time of original installation and also once every year as required by the maintenance program. Experience with relays showed that the time of operation of induction type relays depends upon the wave shape of the test current. Since the wave shape of the fault current in the system is sinusoidal, as has been shown by a large number of oscillograph tests, the testing facilities must either employ a sine-wave current or else in some manner corrections for the wave shape error must be provided.

Sinusoidal current can be obtained through a relay by connecting in series with it a resistance several times higher, in ohms, than the reactance of the relay. This method requires rather bulky test apparatus and a source of high voltage and high capacity not available in most substations. Practical considerations thus call for the use of a step-down transformer; a 2:1 ratio is used in this set.

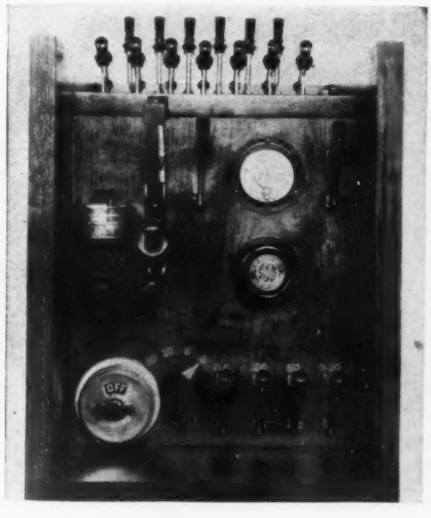
The dotted lines in the group-setting chart are the "apparent" relay curves obtained with the test transformer. The solid lines are the "actual" curves obtained with a water rheostat and a 575-volt alternating-current source. The former curves are furnished to the relay tester, but the latter are used in relay calculations.

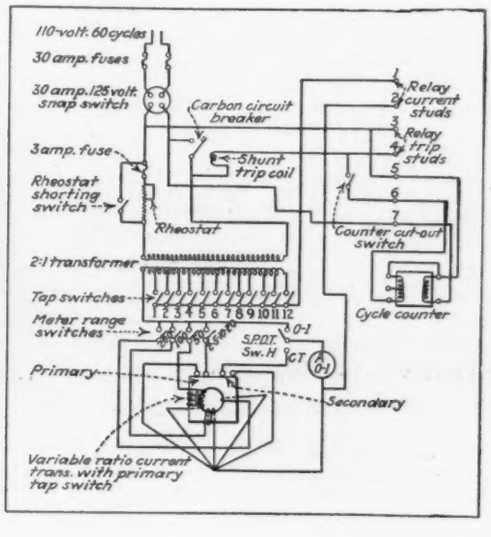
The test set developed for relay testing is particularly interesting in that a single ammeter of 0 to 1 ampere range is used with a variable ratio current transformer to read all magnitudes of current from 0.1 to 200 amp. in steps of 1, 2, 5, 10, 20, 50, 100 and 200 amp. full scale. This set has the range of test current from the minimum operating current of any type of relays to a value twelve or more times the current tap setting of any relay. The set is self-contained except for the cycle counter and weighs 120 lb. complete. One of these sets has stood up to the present time two years of practically daily service with almost no maintenance.



Group settings as developed for definite time-limit relays

It required considerable testing to obtain the correction curves above mentioned. But this investment is fully justified from the point of view of relay maintenance, for accurate timing of overcurrent relays is essential for correct relay performance.





Test set that simplifies relay checking

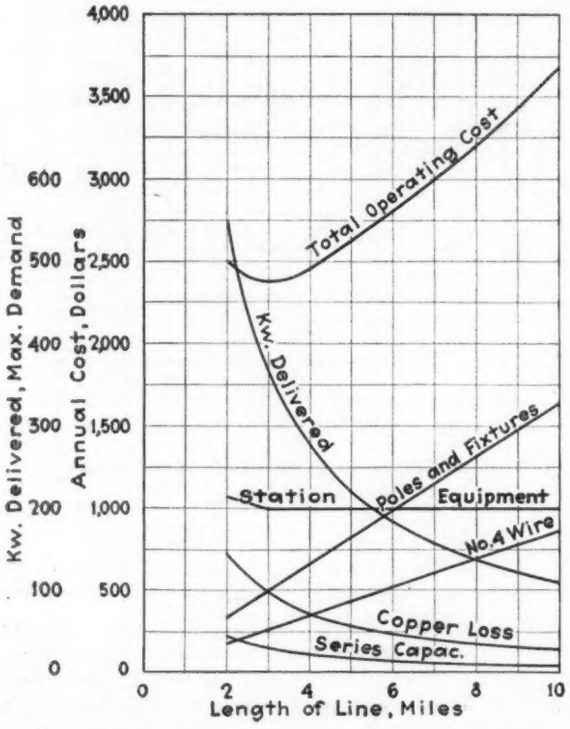
Rural Line Voltages Improved by Neutralizing Reactance

SUCCESSFUL use and considerable experience gained with a series capacitor at the Ballston substation of the New York Power & Light Corporation over a period of two years for the regulation of a 33-kv. transmission line has led to other proposed installations.

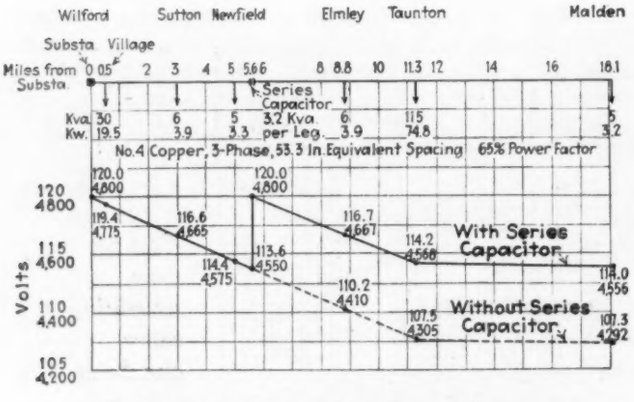
Rural lines may be similarly controlled and F. laT. Budgett of the distribution department, New York Power & Light Corporation, has prepared a detailed study of this subject. The data herewith were presented at the recent meeting of the electric section of the Empire State Gas and Elctric Association.

An accompanying figure shows distances, wire sizes and loads on a 4,600-volt rural line. By the use of a bank of series capacitors 5.6 miles from the substation, 3.2 kva. per leg, the voltage gradient may be improved satisfactorily. The cost of the series capacitors would be about $2,500, whereas the cost of suitable regulators would be about $3,200. Of course, the regulators would compensate for variations in bus voltage as well as line drop, while the capacitors can only take care of the reactive component of the latter. The capacitors, however, will have lower losses.

The various cost factors involved have also been arranged graphically and the operating costs have been based on the following carrying charges: Series capacitor, 15 per cent; copper wire, 10 per cent; poles and fixtures, 12 per cent; substation equipment (oil circuit breaker, regulators, reactors, etc.), 12 per cent.



Cost of voltage regulation with capacitors



Series capacitor raises line voltage

4,000-volt distribution circuit assumed, three phase, 60 cycle, 33.6 in. equivalent spacing, 75 per cent power factor, 10 per cent full-load voltage drop. Series capacitor neutralizes all line reactance and is at substation, No. 4 copper, 1,103 kw.-mils, 20 per cent load factor, 8.8 per cent equivalent hours.

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Equipment Classification for Preliminary Cost Estimates

AS AN aid to making preliminary estimates of electrical equipment costs in generating and substation design the following classification has been found convenient:

1. Main Equipment:
   (a) Main generators, (b) auxiliary generators, (c) exciters, (d) power transformers.
2. Station Auxiliaries:
   (a) Motors, (b) motor control equipment.
3. Bus Structure:
   (a) Bus copper, (b) insulators, (c) supports, (d) concrete work, (e) brick work, (f) alberene slabs, (g) barriers, (h) cell doors.
4. Switchgear:
   (a) Oil circuit breakers, (b) air circuit breakers, (c) air break switches, (d) disconnecting switches.
5. Wires and Cables:
   (a) Main leads with supports; (b) exposed wiring, (c) wire in conduit for power, (d) wire in conduit for control.
6. Conduit Work:
   (a) Fiber duct, (b) manholes, (c) iron conduit, (d) conduit boxes, (e) conduit fittings.
7. Protective System:
   (a) Lightning arresters, (b) impedance coils, (c) individual relays (not on switchboards), (d) fuses and cutouts (not on switchboards).
8. Grounding System:
   (a) Ground rods, pipes or plates; (b) grounding cables, (c) grounding copper and accessories, (d) grounding manholes or handholes, (e) grounding boxes.
9. Station Lighting:
   (a) Lighting transformers, (b) lighting cabinets, (c) conduit for branch lighting, (d) outlet and junction boxes, (e) wire and cable for branch and lighting fixtures, (f) lighting fixtures, including plugs and switches.
10. Signal and Telephone System:
    (a) Operating signals, (b) alarms and annunciators, (c) high line telephones, (d) public telephones, (e) intercommunicating telephones, (f) wired wireless systems, (g) fire alarm system.
11. Switchboards:
    (a) Main control board, (b) relay and instrument board, (c) direct-current switchboards, (d) station power con-

trol boards, (e) station lighting switchboards, (f) feeder control boards, (g) instrument transformers.

12. Miscellaneous Equipment:
    (a) Electric cranes and hoists, (b) passenger and freight elevators, (c) building service equipment (heating, plumbing and ventilation), (d) special metering and indicating devices.

The engineering organization using the above list states that it does not consider it final or complete, since groupings must often be modified according to local conditions. Similarly, unit costs figured on such items must be based entirely on the labor and material applicable to the conditions of each job. The classification is at least useful in preparing cost estimates and for listing items of electrical material to accompany final construction drawings.

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Getting the Family Vote by Direct-Mail Advertising

STRIKING a snag in public sentiment opposed to selling two municipal plants, the Rocky Mountain Utilities Company, Denver, Colo., conceived the idea of trying to influence the women of the two communities by direct-mail advertising. That the idea was sound and that the woman of the household is an influential factor in controlling the family vote is proved by the fact that both towns voted to dispose of their municipal plants to the private company.

A series of letters was sent out stressing better service, lower rates and the fact that the housewife would be able to enjoy the benefits of electrical labor-saving appliances through an easy payment plan to be offered by the company. The first two letters dealt mostly with how the housewife would benefit under private operation of the light plant, while the last two letters dealt more with the company's business proposition. The offer to purchase the small municipal plant was explained and some facts and figures relative to production costs of municipally owned and privately operated light plants were given.

Undoubtedly the letters caused women to give some real thought and consideration to the proposition and proved to be a factor in deciding how they as well as their husbands should vote.

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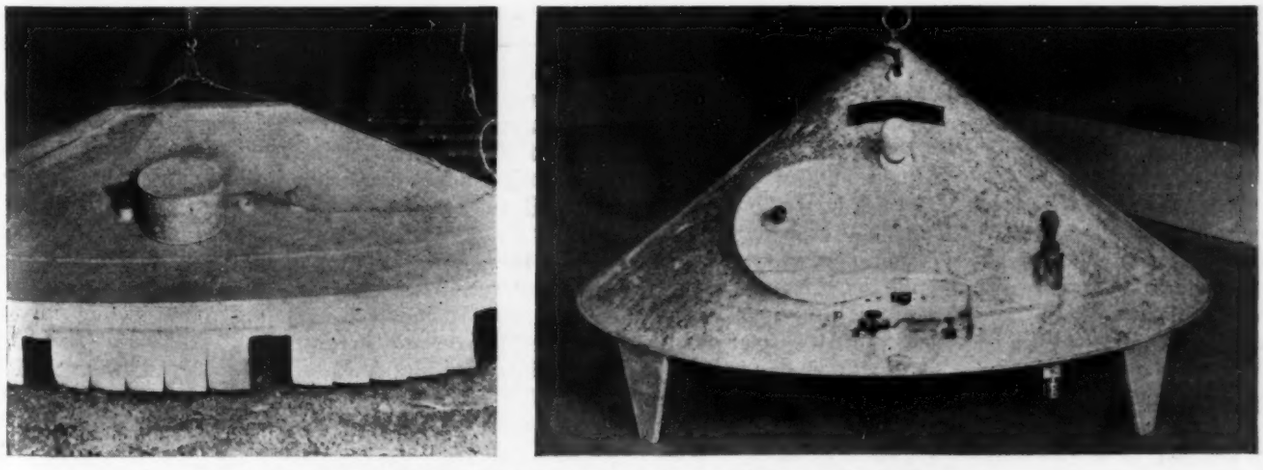
Radiant Type Electric Brooder Revives Application

By T. A. WOOD
Pacific Gas & Electric Company, Santa Rosa, Calif.

PREVIOUS to introduction of the radiant electric brooder the use of electric heat for brooding chicks was on the decline. This reaction was due to faulty brooder design. Conditions are now the reverse and electrically heated units are being added by the hundreds in the Santa Rosa-Petaluma chicken-raising section of California. So important has this type of rural load become that the operation of transmission lines must be governed according to its needs.

The design of the radiant electric brooder required that certain compromises be made in order to obtain a brooder which would remain dry in cold, foggy weather and under crowded chick conditions. The characteristics of the old and the new brooder, for this reason, are quite different. To illustrate this point the radiant brooder cools off much more rapidly than the old type when power is "off" because of the absence of a curtain around the outer edge of the hover. Continuity of service is much more essential in the new type than in the old. The duration of accidental "outages" must be reduced to a minimum if this type of load is to be encouraged, and utility men should encourage the use of "no



NEW AND OLD TYPE ELECTRIC BROODERS

The new brooder on the left is of the radiant type. Reflected heat thrown upon the floor evaporates excess moisture and keeps chicks warm and dry

voltage" alarms on all incubator and brooder installations. Such an alarm is both a protection to the poultryman and the serving company.

The connected loads of the new and old machines per chick rated capacity are quite different. The old machine of 1,000 chick capacity was rated about 1,000 watts or less, or approximately 1 watt per chick. The radiant unit will range from 2 to 3 watts per chick capacity. The load factor has also been materially increased and will average 75 per cent, with times during which there will be no diversity at all for two hours or more.

Data from University of California tests and from private sources indicate that brooders are used twice yearly. Taking this average figure, a 2-kw. brooder will brood during a year 2,000 chicks, representing a consumption of not less than 2,000 kw.-hr. per year. It is not unreasonable to expect a return of approximately $20 per kilowatt of brooder load. There will be in the neighborhood of 500 of these new electric brooders added in the Santa Rosa-Petaluma section this season.

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READERS' FORUM

Measuring Motor-Starting Currents

To the Editor of the ELECTRICAL WORLD:

The article by B. H. Smith appearing in the December 28 issue of the ELECTRICAL WORLD, headed "Measuring Motor-Starting Currents," is of interest as exemplifying the rediscovery of an old idea. Instruments equipped with the pointer "back stop" such as Mr. Smith describes were regularly manufactured for a time in Penacook, N. H., by the old Whitney Electrical Instrument Company some years before it went out of business in 1907. To be sure, these instruments, both in the direct-current polarized vane type and in the alternating-current magnetic vane type, were not inherently well damped, as is the instrument which Mr. Smith describes. In fact, the purpose of the back stops was primarily to make up for the lack of damping by adjustably restricting the arc over which the needle swung after current was applied. For the current rush purpose which is in mind, however, the functioning was the same.

Not only were the direct deflection instruments of the old Whitney Electrical Instrument Company used as described but the so-called dynamometer type, which simultaneously formed part of the same company's line, was similarly used. The ammeters of this dynamometer model had iron vanes for their movable systems, but they were operated like a true torsion dynamometer in that manipulation of a centrally located torsion head button wound up the spring which opposed the motion of the pointer attached to the movable vane. The procedure, of course, was to rotate the button until the index pointer which it carried pointed to the desired current value and then to apply current, observing whether or not the index needle attached to the movable vane swung up to its fiducial mark.

These instruments in their time enjoyed a modest popularity for determining starting currents of elevator motors.

F. R. ROLLER.
Roller-Smith Company,
New York City.

* * * *

Critical Analysis of Station Auxiliary Motors

To the Editor of the ELECTRICAL WORLD:

I was delighted to read my friend C. G. Kilbourne's letter in the January 18 issue of the ELECTRICAL WORLD. Even though he criticises some minor parts of my article, it is a compliment to know that he read it. Mr. Kilbourne is generally right, but this time he is just a little bit off. Because switches and terminals are covered does not mean that they are not there. Even though switches may be closed up in boxes, they should not be so locked that an operator cannot open them. I have seen operators break interlocks with sledgehammers, and I must say that in some cases they were right, because I don't quite fancy the idea of letting a fire spread just because a key is mislaid. I have seen men knocked over grabbing 440-volt fuses, but never saw them knocked over on 220 volts. They should not grab anything, but they do.

Mr. Kilbourne says: "Too much emphasis can hardly be given to the necessity for careful study in the selection of proper alternating-current motors for fans." True, very true indeed, only I claimed the necessity of the same care for all motors, not only for fans. My article recommends the best motor in each case "regardless of cost."

Mr. Kilbourne then advises the world that my suggestion to eliminate all automatic devices on individual motors has already been done in "one power house" in a "somewhat modified form," in which overload is provided on each motor, but set to trip at short circuit only.

This is not a modified form of what I suggest; it is precisely the opposite of what I suggest. And it does not exist in just one power house, but in every power house throughout the world which is not altogether antediluvian. Nobody sets relays on motors for anything but short circuit nowadays. And it is precisely this last remnant of the numerous automatic devices that I suggest should be eliminated. I suggest eliminating all automatic devices from the individual motors, together with all the hickeys, frills and ruffles that go with them, and let a motor be just a motor and not a medicine man.

For this same reason, and not as a matter of money saving, I recommended the elimination of all meters. I believe that it is worth spending more money for less equipment if the added equipment would be useless. But I should really like to know where Mr. Kilbourne buys his meters, because I should like to know where I could secure a whole flock of meters and accessories for the cost of one portable equipment. In every other respect I agree with Mr. Kilbourne.

M. M. SAMUELS.
J. G. White Engineering Corporation,
New York City.

Men of the Industry

F. H. Brooks Now President of Iowa-Nebraska Company

F. H. Brooks of Lincoln, Neb., who was recently made president and general manager of the Iowa - Nebraska Light & Power Company and the Lincoln Traction Company, with headquarters at Lincoln, has been with the

Continental Gas & Electric Corporation, a subsidiary of the United Light & Power Company, since its inception in 1913, first as general manager and then as vice-president and general manager of its properties in Nebraska, Iowa and Missouri, now known as the Iowa-Nebraska Light & Power Company.

Mr. Brooks' public utility career and operating experiences have been broad and varied. He started in the street-railway field in Erie, Pa., in 1896. Later his activities took him into the copper regions of Michigan, where he did electrical engineering work for the Edison company of Sault Ste. Marie and the Peninsula Electric Light & Power Company. In this field Mr. Brooks did pioneering work in hydro-electric and long-distance transmission development. Later he became general manager of the Vicksburg (Miss.) Railway & Light Company.

In addition to management, operating and executive work, Mr. Brooks has also been active in state, sectional and national electric light and power associations. He has been president of the Nebraska Section of the National Electric Light Association and also president of the Middle West Division of the association, comprising Nebraska, Iowa, Kansas and Missouri.

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Harris E. Miller has been appointed to succeed C. I. Weaver as vice-president and general manager of the Ohio Edison Company, Springfield. Mr. Miller has been general superintendent of that company for the past five years and has been associated with the company for fifteen years. In his new position he will have the title of vice-president, general manager and treasurer.

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L. S. Horner has resigned as president of the Niles-Bement-Pond Company to become associated with Kissel, Kinnicutt & Company, bankers of New York. Mr. Horner, who has a background of twenty years of manufacturing experience, will participate in the industrial activities of this financial organization. He is continuing as a director and member of the executive committee of the Niles-Bement-Pond Company.

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J. A. Ward, who has been in charge of the Ohio Electric Power Company, has been appointed manager of the northern division of the Virginia Public Service Company to succeed M. J. O'Connell, who has assumed new duties in Salisbury. Prior to his connection with the Ohio Electric Power Company Mr. Ward was associated with the Northwestern Public Service Company at Huron, S. D.

Frank T. Bolster has assumed general charge of the public utility sales and engineering work of the Rome Wire Company, Rome, N. Y. Mr. Bolster has had wide experience in the public utility field. After spending many years with the United Gas Improvement organization in engineering and operating, he served as operating manager of the Syracuse Lighting Company before transferring his interests to Rome. His wide experience with utility problems and his association and committee work especially qualify him for his new duties.

C. I. Weaver General Manager Cincinnati Utilities

Chauncey I. Weaver, vice-president and general manager of the Ohio Edison Company, Springfield, has resigned to become general manager of the Union Gas & Electric Company and the Cincinnati Gas & Electric Com-

pany of Cincinnati. Both companies are a part of the Columbia Gas & Electric System.

Mr. Weaver had served with the Ohio Edison Company for twelve years, having become associated with it as general manager when it was known as the Springfield Light, Heat & Power Company. Under his leadership the company made rapid strides in Springfield and the suburban territory which the company serves.

A graduate of Kansas State College, Mr. Weaver obtained his early experience in the manufacturing branch of the electrical industry at first with the General Electric Company at Schenectady and later with the Westinghouse Electric & Manufacturing Company at Chicago. In 1912 he became sales manager for Hodenpyl, Hardy & Company at Jackson, Mich., and from that time he has been identified with the public utility industry in the Middle West as manager of the Michigan Power Company, vice-president and general manager of the Springfield (Ohio) Light, Heat & Power Com-

pany and as vice-president and general manager of the Ohio Edison Company. While occupying this executive position he served as president of the East Central Division of the National Electric Light Association, 1927 to 1928.

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DR. A. E. KENNELLY, professor of electrical engineering at Harvard, has been appointed chairman of the American Standards Association's newly set-up committee on electrical definitions. On this sectional committee he represents the A.I.E.E. and other bodies.

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GEORGE W. DUNHAM, until recently vice-president of the Whirldry Corporation, New Haven, Conn., has opened a consulting engineering office in New York. Mr. Dunham was for many years prominent in automotive work. For seven years he has been identified with the development and production of several electrical appliances, especially for domestic use.

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U. S. SENATOR FREDERICK M. SACKETT of Louisville, formerly identified with the public utility industry in Kentucky, on December 28 was named by President Hoover as Ambassador to Germany. Mr. Sackett, a New England man, graduate lawyer, removed to Louisville nearly thirty years ago, and later formed the Kentucky Electric Company, of which he was president. This company built the present Riverside power plant of the Louisville Gas & Electric Company, with which it later merged.

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F. E. ANDREWS, formerly assistant to the engineer of electrical distribution of the Public Service Company of Northern Illinois, has been appointed engineer of electrical distribution. Mr. Andrews began with the Public Service Company in 1917 as an inspector. Two years later he became an assistant engineer in charge of transmission and in 1927 was made engineer of electrical transmission design. He is a graduate of Michigan State College. In 1928 Mr. Andrews was chairman of the Great Lakes Division, National Electric Light Association, Engineering Section.

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CLYDE L. SEAVEY has been elected president of the California Railroad Commission for 1930, in conformity with the policy followed by the commission in recent years of rotating the presidency among its members for a one-year term. He succeeds Thomas S. Loutitt, who served as the presiding officer of the commission during 1929. Mr. Seavey has served on the commission since January 1, 1923.

C. W. Davis Heads Dallas Utility

CHARLES W. DAVIS, vice-president and general manager of the Dallas (Tex.) Power & Light Company for the past ten years, was elected president of that company at the annual meeting of directors, January 14. He succeeds C. E. Calder, who resigned to devote all his time to the affairs of the American & Foreign Power Company, New York, of which he is president.

Mr. Davis was district manager in

Dallas for the Westinghouse Electric & Manufacturing Company when he was elected vice-president and general manager of the Dallas Power & Light Company, ten years ago. He had been for a number of years connected with the Westinghouse company. Prior to that service he was connected with the Southwestern Electric Engineering & Construction Company, Dallas; Palestine (Tex.) Electric Light Company; Warren Electric & Manufacturing Company, Sandusky, Ohio; Chicago Edison Company, Chicago; Fort Wayne (Ind.) Electric Company, Brush Electric Company and Maryland Electric Company in Baltimore, Md.

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L. WARRINGTON CHUBB, manager of the radio engineering department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed first assistant to the vice-president in charge of engineering of the new Radio-Victor Corporation of America with headquarters in Camden, N. J. Mr. Chubb has been active in standardization work, both nationally and internationally, and in the committee work of the leading engineering societies. He has twice been sent, to London and Brussels, as a delegate to the International Electrotechnical Commission. His wide experience in many pioneer fields of development work resulted in the award to him of about 200 patents in the electrical, mechanical, chemical, electrochemical and welding fields. He is a fellow of the A.I.E.E.

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OBITUARY

EARLE O. JOHNSTONE, 46, manager of credit and collections for the Public Service Company of Colorado, Denver, died on January 29 after several months' illness. He had been with the company for about twenty years.

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THOR WOLLEBAK, district manager for the Delta-Star Electric Company and Champion Switch Company at Dallas, Tex., died January 30. Mr. Wollebak had been with the Delta-Star Electric Company in engineering and sales work for eight years and was placed in charge of the Dallas office in June, 1928.

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EVERETT S. THURSTON, manager of the building division of the Westinghouse Electric & Manufacturing Company at Seattle, dropped dead on January 25. Mr. Thurston had spent many years in the electrical jobbing business before joining the Westinghouse company in July, 1925. For three years he was Westinghouse merchandising representative for Montana, with headquarters in Butte. In August, 1928, he was transferred to the Seattle office.

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FRED M. KIMBALL, advisory manager of the motor division, industrial department of the General Electric Company, died on February 4 at Lynn, Mass., after an illness. He had seen many years of service with the General Electric Company and was well known throughout the motor industry. He was born in Barton, Vt., July 7, 1861, and received his education in Massachusetts, including a course in electrical engineering at the Massachusetts Institute of Technology. His early associations were with the Merchants' Electric Light Company of Boston, the American Electric Illuminating Company and the Electrical Development & Manufacturing Company. He was in business from 1886 to 1891, when he entered the General Electric employ in the New England district. In 1898 he was made manager of the small-motor department on its formation. He was an associate member of the A.I.E.E. and a member of the N.E.L.A. and the Edison Pioneers.

Financial and Statistical News

MUCH of the 1930 utility financing will come from the execution of rights by stockholders. Last year approximately $450,000,000, in addition to what was issued and later canceled owing to the market situation, was offered. A substantial volume of rights offered toward the latter part of the year are still to be exercised.

——THE SWING BACK TO BONDS on the part of large investors is not as complete as was anticipated. The common stock "complex" has certainly not been eliminated.

——MUCH LESS IS HEARD of an expected further decline in the market in late February and early March than was heard a month or so ago. Investment authorities seem more and more convinced that the secondary reaction is over. A slow market retarded by the necessity of digesting a large volume of stock seems to be anticipated rather than a further material deflation in prices.

NEWS BRIEFS

The Central Electricity Board of Great Britain evidently misjudged the market in its attempt to float a $35,000,000 issue of 5 per cent stock recently. It is stated that the underwriters had to take up 92 per cent of the issue, the public taking only a small portion.

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Annual report of United States Fidelity & Guarantee Company for 1929 shows that organization is holding public utility bonds having a market value of $9,506,342, or 23 per cent of the total of all bonds held, and $1,544,150 of public utility stocks, or 13 per cent of the total of stock holdings.

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Pacific Gas & Electric Company reports rights recently offered to buy common stock at $40 are 99 per cent exercised.

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C. J. Rockwood, receiver for the W. B. Foshay Company, announced a collateral foreclosure sale of $239,000 principal amount of first mortgage 5½ per cent bonds, due in 1948, of the Public Utilities Consolidated Corporation of Arizona by George M. Forman & Company.

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Baltimore Consolidated Offers Rights

CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY of Baltimore will ask for $6,367,620 additional capital through an offer of rights to stockholders to subscribe to 106,127 shares of common stock at $60 a share in the ratio of one new share for each ten held. The offering relates to stock of record February 28 and rights expire April 1.

After flotation of the present issue the company will have outstanding 1,150,842 shares of common out of a total authorized issue of 1,200,000 shares. The dividend on the stock was increased last month from $3 annually to $3.60 a share with a quarterly dividend of 90 cents a share.

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Light and Power Equal in Portugal

THE FOLLOWING short table, based on a report of the electrical division of the State Hydraulic Service of Portugal, shows the percentages of the different uses of electrical energy in that country during 1928 and 1927:

	1928 Per Cent	1927 Per Cent
Lighting	30.29	32.79
Traction	28.68	28.34
Power	33.97	33.57
Electrochemical industries	7.06	5.30
	100.00	100.00

Lisbon and Oporto are the two principal electricity-using cities of the country, they being responsible for 64,826,206 kw.-hr. and 31,671,139 kw.-hr. of the output, or 122 kw.-hr. and 147 kw.-hr., respectively, per inhabitant per annum. The average for the whole population of the country is, however, only 33 kw.-hr., although this is an increase of 5 kw.-hr. over 1927.

The output per capita of public utility plants in the United States is about 25 times as great.

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Insull Company Shows 13 per Cent Net Growth

A GAIN of approximately 13 per cent in operating revenue was shown for 1929 by the Public Service Company of Northern Illinois. Last year's figure was $33,329,810. After the payment of $4,064,578 in dividends, $3,036,291 was carried to surplus.

The Public Service Company of Northern Illinois has shown a steady upward trend over a period of years. Gross operating revenues have more than doubled since 1923. During that period expenses have been cut down so that the operating ratio has dropped from 66.8 per cent in 1923 to 58.9 per cent in 1928 and approximately 54 per cent in 1929. The balance carried to surplus has expanded steadily from $763,197 in 1923 to $3,036,291 last year. The number of customers has shown a steady and creditable increase. In 1925 there were 205,214 electric customers, while last year there were 282,438.

During 1929 electric service was extended to a large number of communities and a substantial addition was made to existing business. During the year the company made a contract with the Illinois Northern Utilities Company and the Rockford Electric Company for the interchange of electric energy over a new 132,000-volt steel tower transmission line extending a distance of 43 miles.

Total kilowatt-hours of electricity sold during the year were 1,056,558,905, which is an increase of 18.2 per cent over 1928. Exclusive of energy sold to

other electric companies, sales totaled 706,734,774 kw.-hr., an increase of 11.5 per cent over 1928. Sales of electric energy for residential and commercial lighting for the year amounted to 166,-955,116 kw.-hr., an increase of 14.9 per cent.

Rights sold to shareholders

An interesting phase of financial operations for the year was the sale of a substantial block of common stock to shareholders. In September the company offered 94,700 additional shares of no-par common stock to shareholders for subscription at $100 per share in the ratio of one share of new stock for each six shares of their holdings of stock in all classes. At the close of the subscription period, November 1, a total of 94,395 shares, or 99.6 per cent of the total stock offered, had been subscribed for. The remainder was later sold. This operation is indicative of the large amount of capital secured through the issue of rights by the utilities last year. There was also provision made for the sale of about 30,000 shares of common stock to employees on the same basis.

At the end of the year the surplus account showed $13,326,489. An allowance of $2,400,000 was made for retirement purposes. Total assets at the end of the year amounted to $190,027,-594, which represents an increase of almost 10 per cent during the year.

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Can the I.C.C. Establish Its Valuation Theory?

NOTHING daunted by the Supreme Court's dictum that some weight must be given to cost of replacement in fixing the value of railroad properties for rate-making and recapture purposes —a finding that had obviously great importance for utilities as well as railroads —the Interstate Commerce Commission has recommended that Congress should write into the law a method that in principle and practical results is the same as that applied by the commission in the celebrated O'Fallon case. In one bold move the commission has attempted to wrest victory from defeat. If the commission can prevail upon Congress to accept its recommendation, it will have succeeded in establishing, in terms of law, its theory of valuation.

The commission's counter move followed immediately upon a hearing on January 23-24 called by the commission to consider how the court's precept that cost of reproduction new should be considered as an element of value should be applied. As outlined in a letter addressed by Commissioner Eastman to Senator Couzens, chairman of the Senate interstate commerce committee, up-to-date valuations under the commission's "modified" method "would be determined by taking the cost of reproduction new at the 1914 unit prices of the property existing on the original valuation date, plus the then value of the lands, adding or subtracting the subsequent net increase or decrease in the property investment account as shown by the accounts when correctly kept, adding further a proper allowance for working capital and deducting the balance standing in the depreciation reserve."

This method ignores the present cost of old property and differs in only two respects from that employed by the commission in placing a value on the St. Louis & O'Fallon Railway: (1) The amount standing in the depreciation reserve is substituted for an "*x*" amount that can be determined only by continued reappraisal of land and constant physical inspection of railroad property and (2) "going concern" and other intangible elements of value which contributed $50,000 to the O'Fallon total are eliminated from consideration.

The commission urges that a definite declaration of public policy by Congress is desirable, even if it does not agree with its proposal regarding method. On this point:

> We believe that it is not only appropriate, but highly desirable, that Congress should by definite direction to this commission indicate its views as to how we should exercise reasonable judgment in arriving at both "fair value" and "fair return." Fundamentally, this is not a question of technical law, but a question of what is "just and right." There is, therefore, every reason for a definite declaration of public policy upon this matter in the first instance from the fountainhead of legislative power, rather than from a mere agent of Congress, which is what this commission is. The result of such declaration would, of course, be subject to review by the Supreme Court, if it were contended in any instance that they transgressed constitutional limitations; but in that event we feel sure that a broad declaration of public policy from the legislative branch of the government, particularly if accompanied by the reasons therefor, would be of great help to the Supreme Court. It could hardly be otherwise. One of the great difficulties indeed which the courts have in the past encountered in dealing with this subject has been that the legislative bodies, federal and state, have never undertaken to make such a declaration. It would in effect amount to a legislative determination of the weight to be given the various elements of value, a matter which, as we have seen, the Supreme Court has thus far carefully refrained from foreclosing.

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NEW CAPITAL ISSUES

United States Electric Light & Power Shares, Inc., is offering a new issue of series B trust certificates. These certificates will be offered at $10.25. The units now offered by the corporation are composed of common stocks of 44 public utility companies supplying 80 per cent of the nation's electrical energy.

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General Public Utilities offers an issue of $4,000,000 6 per cent convertible notes to mature December 1, 1931. The notes are priced at 99 and accrued interest to yield 6.60 per cent. The proceeds of these notes will be used to retire presently maturing obligations and bank loans.

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Offering of $15,000,000 Electric Power & Light Corporation debentures 5 per cent series, due 2030, is made at 92½ and accrued interest to yield about 5.40 per cent. Electric Power & Light Corporation is under Electric Bond & Share supervision.

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The Green Mountain Power Corporation offers an additional issue of $1,015,000 first mortgage 5 per cent gold bonds, series of 1948. The purpose of the issue is not stated. The gross revenues of the corporation for the year ended December 31, 1929, were $1,955,-370 and the balance which was available for interest amounted to the sum of $1,227,827.

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Cities Service Suit Dismissed

SUIT BROUGHT by Hugo Cohn against the Cities Service Company to restrain the company from rescinding the offer announced in October permitting stockholders to purchase additional stock at $45 a share was dismissed, as was the suit brought by Charles Quincy, a debenture holder who sought the same restraint in connection with the offering to debenture holders.

Cities Service Company withdrew its offer after the market break brought the common stock below the exchangeable price. Judge Bondy in dismissing the case ruled that nothing in the company's letter to stockholders prevented the withdrawal of the offer prior to its acceptance.

Commonwealth Earns $12.05 per Share

COMMONWEALTH EDISON COMPANY gross revenue from operations last year increased by $6,443,968 to $83,486,744. Net operating income was up $847,660 to $16,322,769, which amounts to $12.05 a share on the common stock outstanding during the period which is under study.

After dividends $6,254,897 was added to surplus, bringing the total to $40,794,813, against $35,143,064 the previous year. Total assets, including fixed capital, of $286,736,277 increased to $375,966,120.

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Aluminum Company Will Segregate Utility Plants

APPROVAL by the New York Public Service Commission on January 30 of an application by the Aluminum Company of America has, according to a memorandum written by Commissioner George R. Lunn, given effect to a determination on the part of the Aluminum Company to separate the ownership and control of the companies affiliated with it whose business is directly connected with its manufacturing plant from those engaged in a public utility business.

The stock of the St. Lawrence River Power Company, whose product to the extent of more than 99 per cent is used by the Aluminum Company of America, will be transferred to the Massena Securities Corporation (organized in September, 1929) from the St. Lawrence Securities Company, which owns a number of other public utility corporations. The stock of the Massena Terminal Railway Company will be acquired by the Aluminum Company, of which it is primarily a plant facility, from the St. Lawrence Securities Company.

The Massena Securities Corporation will pay $129,126 for the stock of the St. Lawrence River Power Company and the Pine Grove Realty Company and assume the liability of the St. Lawrence Securities Company to the St. Lawrence River Power Company, amounting to more than $5,000,000. An electric transmission line used solely to serve the Aluminum Company and extending from the Canadian border to the substation of the Aluminum Company near Massena will be transferred from the St. Lawrence County Utilities to the St. Lawrence River Power Company.

"The result that will be accomplished by the proposed transfers and the shifting of securities appears to be in the public interest," Commissioner Lunn said. "It is desirable that companies engaged in a utility business be kept separate and distinct from those engaged in a purely manufacturing undertaking."

Associated Gas Sells More Merchandise

DISTRIBUTION OF MERCHANDISE by the Associated Gas & Electric System during 1930 should approximate $8,675,000, according to official estimates made. This compares with $6,005,000 in 1929 from all Associated properties except those acquired recently. Of this total it is anticipated that the greater part will be derived from electric merchandise and the balance will come from sales of gas apparatus.

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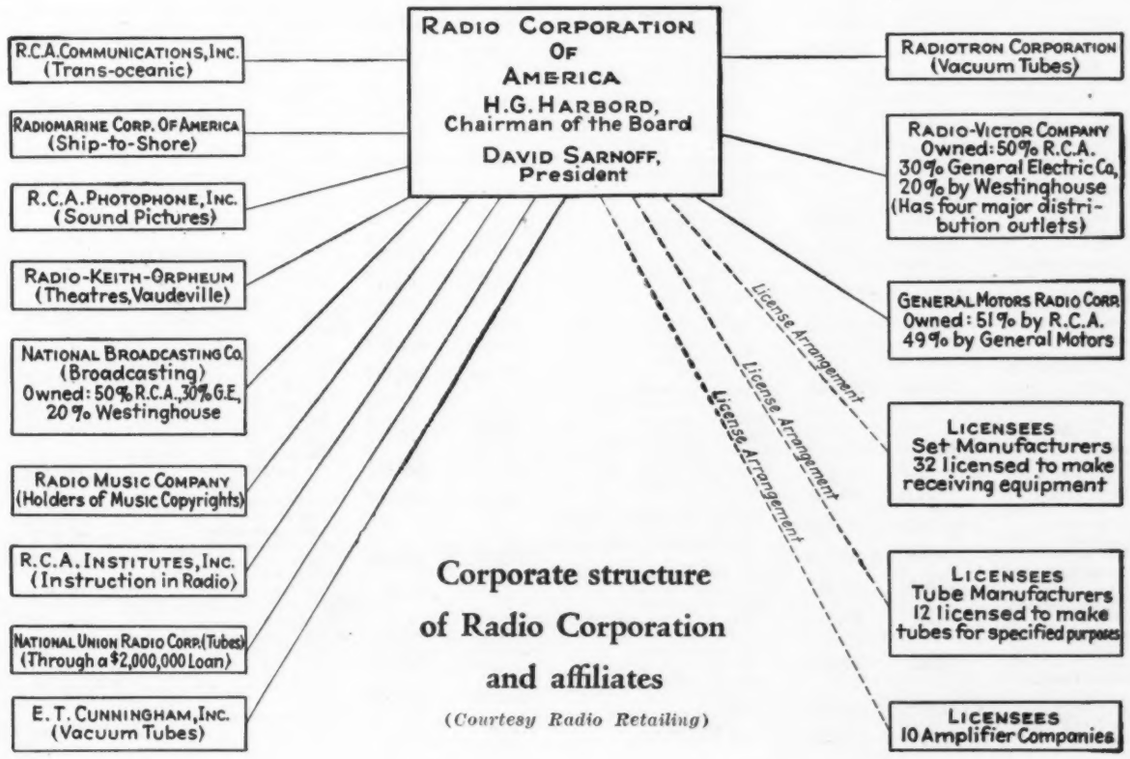
Utility Buys Oil Property

HENRY L. DOHERTY & COMPANY has purchased the oil and gas holdings of the Foster Petroleum Corporation in the Oklahoma City section of the mid-continent field, subject, of course to action of the stockholders.

The property is to be taken over by the Indian Territory Illuminating Oil Company, one of the largest producers of high-grade crude oil in the world and a subsidiary of Cities Service. Oklahoma City field was opened in 1928, by a discovery well of the Indian Territory Company. Since then this company and the Foster Petroleum Corporation have brought in jointly owned wells. These companies have completed a total of 43 producing wells in this field and promise a steady growth.


RADIO CORPORATION OF AMERICA
H.G. HARBORD, Chairman of the Board
DAVID SARNOFF, President
R.C.A. COMMUNICATIONS, INC. (Trans-oceanic)
RADIOMARINE CORP. OF AMERICA (Ship-to-Shore)
R.C.A. PHOTOPHONE, INC. (Sound Pictures)
RADIO-KEITH-ORPHEUM (Theatres, Vaudeville)
NATIONAL BROADCASTING CO. (Broadcasting) Owned: 50% R.C.A., 30% G.E., 20% Westinghouse
RADIO MUSIC COMPANY (Holders of Music Copyrights)
R.C.A. INSTITUTES, INC. (Instruction in Radio)
NATIONAL UNION RADIO CORP. (Tubes) (Through a $2,000,000 Loan)
E. T. CUNNINGHAM, INC. (Vacuum Tubes)
RADIOTRON CORPORATION (Vacuum Tubes)
RADIO-VICTOR COMPANY Owned: 50% R.C.A. 30% General Electric Co. 20% by Westinghouse (Has four major distribution outlets)
GENERAL MOTORS RADIO CORP. Owned: 51% by R.C.A. 49% by General Motors
License Arrangement
License Arrangement
License Arrangement
LICENSEES Set Manufacturers 32 licensed to make receiving equipment
LICENSEES Tube Manufacturers 12 licensed to make tubes for specified purposes
LICENSEES 10 Amplifier Companies

Corporate structure of Radio Corporation and affiliates

(Courtesy Radio Retailing)

Business News and Markets

Creditors' Committee for International Combustion

IN VIEW OF THE appointment of receivers for the properties of International Combustion Engineering Corporation, Coshocton Iron Company, Hedges-Walsh-Widener Company, Heine Boiler Company and International Combustion Tar & Chemical Corporation, a committee has been formed to protect the interests of the creditors of International Combustion Engineering Corporation and its owned and affiliated companies and to represent these creditors in consideration of any readjustment plan. Members of the committee are: G. L. Bourne, president Superheater Company, who is chairman; H. J. Hirshman, treasurer National Tube Company; R. E. McMath, vice-president and secretary Bethlehem Steel Company; Frank J. O'Brien, president Globe Steel Tubes Company; Homer D. Williams, president Pittsburgh Steel Company, and S. L. Probasco, vice-president American Trust and Banking Company, Chattanooga, Tenn.

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CROCKER-WHEELER ELECTRIC MANUFACTURING COMPANY will offer 58,100 shares of no-par common to its stockholders of record February 3 at $15 a share in the ratio of one new share for each four shares held. Rights will expire February 24.

General Cable Acquires New Plant

GENERAL CABLE COMPANY, New York, has purchased the plant and business of the Peerless Insulated Wire & Cable Company, Pennington, N. J., manufacturer of special wires, cables, etc., and will consolidate with its organization. The Pennington plant will be continued in service and will be under the direction of the Standard Underground Cable Company, a division of the purchasing company, Pittsburgh, Pa., and Perth Amboy, N. J., which is now concentrating the bulk of production at the last noted works. It is understood that the Pennington plant will be maintained along the present line of output. The

EXPORTS OF ELECTRICAL EQUIPMENT (PRELIMINARY)

Article	November 1928	November 1929
Generators:		
Direct current—		
Under 500 kw.	135,121	96,369
500 kw. and over	48,764	63,981
Alternating current—		
Under 2,000 kv.-amp.	14,503	29,501
2,000 kv.-amp. and over	23,196	84,743
Steam turbo-generator sets	50,419	170,909
Accessories and parts for generators	98,586	188,021
Self-contained lighting outfits	131,469	113,706
Batteries:		
Flashlight batteries	333,267	343,893
Other dry and wet cell primary batteries	197,749	.....
Radio B and C batteries (dry)	.....	55,006
Other, not elsewhere specified	.....	123,485
Storage batteries	275,905	332,585
Transforming or converting apparatus:		
Power transformers, 500 kw.-amp. and over	86,052	80,554
Distribution transformers, less than 500 kv.-amp.	71,429	93,016
Instrument transformers	8,180	13,509
Other transformers, not elsewhere specified	118,876	168,721
Complete battery chargers under 15 amp	27,461	12,738
Rectifiers, double current and motor generators, dynamotors, synchronous and other converters	97,842	100,702
Transmission and distribution apparatus:		
Switchboard panels, except telephone	110,883	125,755
Switches, and circuit breakers over 10 amp.	147,659	165,673
Fuses and fuse blocks	40,772	38,022
Watt-hour and other measuring meters	117,310	110,651
Electrical indicating instruments	42,518	59,789
Electrical recording instruments	16,067	32,482
Other electrical testing apparatus	89,347	79,064
Lightning arresters, choke coils, reactors, and other protective devices	56,303	85,447
Motors, starters and controllers:		
Motors, ½ hp. and under	195,480	230,566
Motors, over ½ and under 1 hp	55,731	61,016
Stationary motors—		
1 to 200 hp.	449,544	328,014
Over 200 hp.	32,594	24,687
Railway motors	18,355	800
Electric locomotives—		
Railway	53,182	243,492
Mining and industrial	26,065	91,050
Station and warehouse electric motor trucks	1,775	6,017
Starting and controlling equipment—		
For industrial motors	129,443	170,692
For electric railway and vehicle motors	15,810	40,633
Portable electric tools	93,289	.....
Portable electric tools, except automotive	....	90,086
Automotive electric machine tools	.....	1,326
Accessories and parts for motors	247,820	261,813
Electric appliances:		
Electric fans	84,653	74,450
Electric lamps—		
Metal filament	134,075	90,519
Other electric lamps	84,194	62,230
Flashlights	194,241	201,581
Searchlights and projectors	53,733	47,614
Motor-driven household devices—		
Electric household washing machines	166,441	161,018
Electric vacuum cleaners	135,307	169,122
Other motor-driven devices, except tools	56,047	91,572
Electric flatirons	42,941	24,260
Electric cooking ranges	38,156	33,367
Other domestic heating and cooking devices	110,027	100,353
Industrial electric furnaces and ovens	23,084	41,079
Therapeutic apparatus, x-ray machines, galvanic and faradic batteries, etc.	171,997	176,373
Signal and communication devices:		
Radio apparatus—		
Transmitting sets and parts	76,207	166,001
Receiving sets	753,856	1,647,939
Tubes	86,291	234,419
Receiving-set components	363,720	551,735
Other receiving-set accessories	349,377	.....
Loudspeakers	.....	220,093
Other receiving-set accessories, n. e. s.	.....	220,180
Telegraph apparatus	96,309	191,456
Telephone apparatus—		
Telephone instruments	53,493	95,525
Telephone switchboards	22,323	235,322
Other telephone equipment	198,911	402,883
Railway signals, switches and attachments	54,778	60,915
Bells, buzzers, annunciators and alarms	31,208	47,558
Other electric apparatus:		
Spark plugs	175,182	112,574
Other starting, lighting and ignition equipment	49,826	107,227
Insulating material	110,149	126,112
Metal conduit, outlet and switch boxes	111,397	117,537
Sockets, receptacles and lighting switches	170,941	164,632
Electric interior lighting fixtures	218,074	220,402
Electric street lighting fixtures	106,049	58,482
Other wiring supplies and line material	73,355	[145,830
Other electrical apparatus, not elsewhere specified	811,956	1,048,401
Rubber and friction tape	40,566	42,040
Globes and shades for lighting fixtures	61,109	54,002
Electrical glassware, except for lighting	39,743	22,629
Electrical porcelain:		
For less than 6,600 volts	56,746	67,125
For 6,600 volts and over	78,569	71,555
Electrodes and carbons:		
Electrodes for electric furnaces	163,423	185,862
Other carbon products	70,298	46,464
Insulated iron or steel wire and cable	29,216	48,867
Copper, bare wire	240,031	192,209
Copper, insulated wire and cable	405,069	463,176
Refrigeration sets up to 1 ton capacity	799,872	.....
Refrigeration sets up to ½ ton capacity	.....	491,249
Refrigeration sets over ½ to 1 ton capacity	....	95,984
Totals	$10,851,706	$13,548,437
Eleven months ended Nov. 30	100,474,003	137,130,971

Standard Underground Cable Company has been carrying out an expansion program at its Perth Amboy plant, including the erection of several manufacturing units and new office building.

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Copper Market Active

	Jan. 29, 1930 Cents per Pound	Feb. 5, 1930 Cents per Pound
Copper, electrolytic....	18	18
Lead, Am. S. & R. price	6.25	6.25
Antimony.....	8¾	8¾
Nickel, ingot.....	35	35
Zinc, spots.....	5.60	5.60
Tin, straits.....	39¼	38¾
Aluminum, 99 per cent	24.30	24.30

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Four Giant Generators for Russia

FOUR 77,500-kva. hydro-electric generators, the largest in the world, are being manufactured by the General Electric Company for the Dnieper River development at Kichkas, near Zaporozhe, in the Ukraine. The development will supply power in the vicinity of Dnepropetrovsk and through the southern part of the Union of Socialist Soviet Republics.

The total weight of each generator will be approximately 1,760,000 lb., while the weight of the rotor and shaft will approach 980,000 lb. The maximum diameter is approximately 42 ft., while the generators will have an over-all height of 40 ft. 5 in., of which 17½ ft. will extend above the floor of the plant.

Large castings have been eliminated by the use of fabricated welded construction.

Shipment of the several thousand parts will be made by railroad from Schenectady to New York, where they will be loaded on a boat bound for the mouth of the Dnieper River. Though railroad facilities in that section of Russia are considered good, part of the shipment will be made by barge up the river to the site of the plant, where a special 50-ton crane will have to be installed to handle the pieces of apparatus. About 130 railroad cars will be required for the shipment.

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TRADE BRIEFS

Locke Insulator Corporation of Baltimore, Md., announces the removal of its Philadelphia office to Rooms 1711-1713 1405 Locust Street. J. G. Dellert, district manager; G. M. Ruoff, covering Pennsylvania and New Jersey, and W. F. Schoonmaker, covering Virginia, Maryland and Delaware, will have headquarters at this office.

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Electric Power Equipment, Ltd., is the new name of Bartholomew, Montgomery & Company, Ltd., 510 West Hastings Street, Vancouver, B. C.

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Struthers Dunn, Inc., has found it necessary, because of increased demand for "Dunco" products, to move to larger and more adequate office and factory quarters at 139 N. Juniper Street, Philadelphia. The firm was formerly located at 1130 Race Street, Philadelphia.

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Wubco Battery Corporation, a division of the Electric Auto-Lite Company, has purchased a new factory site in Swissvale, Pa., where its present factory is located. A modern storage battery manufacturing plant will be erected on the new site immediately.

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Market Conditions

INDUSTRIAL BUSINESS in the East is more or less marking time. Power plant business is about normal, with promise of a substantial improvement during this month and next.

——MUNICIPAL BUSINESS ON THE PACIFIC COAST has been a feature this week. The power companies have also been buying actively.

——THE SOUTHEAST AND NEW ENGLAND report business steady but featureless.

EASTERN

—BUSINESS HAS FALLEN *into a routine channel in the electrical equipment market at New York and the past fortnight shows a situation of noticeable sameness. A fair amount of commitments is being placed by central stations, with inquiries developing into a better volume.*

—ELECTRIC RAILWAY *account continues in a very satisfactory manner and the immediate outlook is promising.*

—INDUSTRIAL DEMAND *continues light, although the call for motors and the outlook is promising.*

A bright spot in power station account is the orders placed by the State Line Generating Company for two turbo-generator units for its plant at Hammond, Ind., one to be furnished by the General Electric Company, with rated capacity of 150,000 kw., the other to be built by the Allis-Chalmers Manufacturing Company, with capacity of 125,000 kw. The two units, with auxiliary apparatus, will cost about $3,500,000; an award for water-tube boilers has been placed with the Babcock & Wilcox Company, and other required equipment will be ordered at an early date. A Connecticut power company has contracted with a New York manufacturer for transformers, switchgear and kindred apparatus to an amount of $200,000. A central station in New Jersey has given an order to the same maker for a quantity of similar substation equipment to cost approximately $400,000. Other business of this character is showing increasing strength for spring deliveries.

Industrial demand is centered in motors, controls and affiliated apparatus. Steel and iron plants lead in present call and an early sizable account is looked for from that quarter.

Electric railway business can account for another sizable order, placed by the Erie Railroad Company for ten gasoline-electric cars to supplant steam locomotives on its suburban lines. The Pennsylvania Railroad Company is pushing its electrification program between Trenton and Newark, N. J., and has purchased property at Metuchen for a power substation, plans to be prepared.

CONSTRUCTION PROJECTS

Cork Insulation Company, New York, plans plant at Wilmington, Del., to cost over $125,000. United Verde Copper Company, New York, contemplates lead, zinc and copper mill in vicinity of Presidio, Tex., reported to cost more than $750,000. Signal Supply Officer, U. S. Signal Corps, New York General Depot, Brooklyn, will receive bids until February 18 for 116 power units and accessories (Circular 85). Beebee Island Corporation, Watertown, N. Y., is said to be planning a hydro-electric power plant to cost more than $1,000,000. Columbia University, New York, plans an engineering building to cost in excess of $1,000,000. Hamburg, N. Y., plans installation of an ornamental street-lighting system. American Gas Products Corporation, New York, will establish a plant at Belleville, N. J. Jersey Central Power Company, Asbury Park, will make extensions in transmission lines, including

steel tower line to Freneau and vicinity. East Orange, N. J., plans extensions in street-lighting system. Philadelphia Electric Company, Philadelphia, Pa., plans construction of steel tower transmission lines through Montgomery and Bucks Counties to New Hope, Pa. Pennsylvania Railroad Company, Philadelphia, Pa., will make extensions in engine house and shops at South Philadelphia, reported to cost over $100,000. Department of Properties and Supplies, Harrisburg, Pa., will soon take bids for a power plant at East Stroudsburg, Pa., to cost about $50,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until February 18 for electric wire and cable for eastern and western yards (Schedule 2757); at same time, for two turbo-generator sets and spare parts for the Brooklyn navy yard (Schedule 2776); also, at same time, for pressure and vacuum gage for Puget Sound and Mare Island yards (Schedule 2755).

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SOUTHWEST

—THE GENERAL TONE *of this market has improved since last week. Central station buying is still strong and the demand for stock sizes of apparatus has increased to the high level of previous reports.*

The following contracts have been closed: A 7,500-kw. turbo unit with surface condenser 15,000 sq.ft. to cost $160,000, a switchboard for a southwestern power company to cost $10,000, a lot of motors from 10 hp. to 250 hp. worth $12,000 for an oil refinery, a lot of motors for contractors' plant on a large municipal job totaling $3,500, six transformers 100 kva. each for a southern power company to cost $4,000 and a miscellaneous lot of motor and transformer equipment for an industrial plant costing $10,000.

CONSTRUCTION PROJECTS

St. Louis & San Francisco Railway Company, St. Louis, Mo., will soon take bids for addition to engine house and shops at Springfield, Mo., to cost more than $100,000. Brockman Manufacturing Company, St. Louis, Mo., plans addition to steam specialty manufacturing plant to cost $100,000. Kirksville, Mo., contemplates municipal electric light and power plant to cost $250,000. Southwestern Bell Telephone Company, Joplin, Mo., plans repeater and cable station to cost $325,000. Purcell, Okla., plans extensions and improvements in street lighting system. Gulf States Utilities Company, Beaumont, Tex., plans transmission line from Beaumont to Dayton, Tex., with substation facilities. Magnolia Petroleum Company, Dallas, Tex., is reported planning oil refinery at Sweetwater, Tex., to cost $2,500,000. Gulf Public Service Company, New Iberia, La., plans extensions in power station and lighting system at Winnfield, La., to cost $80,000. Public Service Company, New Orleans, La., plans extensions in lighting system. Louisiana Power & Light Company, New Orleans, La., plans transmission line to paper mill of Bogalusa Paper Company, Bogalusa, La., with power substation, to cost more than $200,000. Hillyer-Fuller-Edwards Lumber Company, Glenmora, La., plans extensions and improvements in light and power plant, including equipment to double present capacity. Shreveport, La., plans installation of flood lighting system and beacon lamps in connection with municipal airport to cost $300,000.

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PACIFIC COAST

—MUNICIPAL PURCHASES *and projects have featured the past week, including a proposed $60,000,000 bond issue covering the purchase by San Francisco of private power companies now serving the city.*

—NEVADA AND ARIZONA *building construction is very good, especially near California borders.*

Orders include purchase of feeder regulators, reactors and circuit breakers by Glendale, $35,000 worth of Westinghouse feeder regulators for Los Angeles, requests for bids for floodlighting Oakland City Hall, a $1,000,000 building for San Francisco civic center group, a carload of 1/0 bare copper wire and cable terminals for Los Angeles and 15,000 feet of six-pair underground park cable for San Francisco. Contractors report unusually high proportion of such public buildings as hospitals, auditoriums and memorials.

Railroad buying covers carloads of rigid iron conduit, rubber-covered wire and three months' requirements of all standard wiring items for one road. Power company purchasing is comparatively light, although approximately $200,000 each for central California poles and transformers are in abeyance. However, the week's power purchases include carloads each of fiber duct and poles and a $90,000 Westinghouse switchboard for San Francisco. Industrial buying covers such items as four General Electric motor-generator sets value $15,000 for radio transmission, a $10,000 switchboard for a Hawaiian sugar plantation and a special 125-hp. motor and accessories value $4,000 for Idaho fruit car refrigeration. January sales of distributing transformers have averaged close to 600 per week, over twice the normal. The state purchased a motor-generator welding set and bids are being received for fixtures for the new U. S. marine hospital in San Francisco.

General Electric Company, bidding $366,000, submitted low offer to board of contracts and awards in Tacoma on February 3 for furnishing 25,000-kw. turbo-generator set and accessories for $2,000,000 steam-generating plant to be built by municipal lighting department. Other bidders were Westinghouse, $368,500, and Allis-Chalmers, $370,450. Motor and apparatus sales, reported very light last week, included a 90-kva. alternator equipped with Diesel engine for an Oregon sanitarium, fifteen 2 2/10-hp. special motors for a sawmill equipment manufacturer, 26 motors from 40 hp. down for sawmill and woodworking plants, a 225-kw. generator and six 30-hp. motors to an Oregon sawmill, five motors from 60 hp. down to a Puget Sound industrial plant, a 150-hp. motor to a water system, 40 pumps costing about $28,000 to a pulp and paper mill in Puget Sound district and five machines from 25 hp. down to a grain elevator. Provincial government, Victoria, B. C., is taking bids until February 24 for construction of power house, mechanical equipment and service lines at mental hospital at New Westminster, and a pump company at Okanogan, Wash., will take bids shortly for a 200-hp. pumping unit.

CONSTRUCTION PROJECTS

Standard Gasoline Company, Los Angeles, Calif., a subsidiary of Standard Oil Company, will build a plant in Kettleman Hills section to cost $400,000. Great Western Power Company, San Francisco, Calif., plans power substation near Hayward, Calif., and extension of transmission lines in that section to cost more than $1,000,000. Glendale, Calif., will build a power substation to cost $80,000. Portland Electric Power Company, Portland, Ore., is completing plans for addition to steam-operated electric power plant to cost $700,000. Mount Pleasant, Utah, plans extensions and improvements in municipal electric light and power plant, including additional equipment. Southern Colorado Power Company, Pueblo, Colo., plans extensions and improvements in power substations at Fowler, Rocky Ford and Las Animas, Colo., including installation of additional equipment.

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NEW ENGLAND

—THE PAST MONTH *was one of encouraging activity in electrical equipment sales in this district. Industrial equipment sales during the past week were steady.*

—SMALL MOTOR *sales maintained an even trend and some activity is reported among manufacturers of small electric power tools who are interested in fractional-horsepower motors.*

A number of large group orders recently placed are of interest, one of which, with accessories, exceeded $30,000 and another of over $40,000. Small switches and control equipment sales are active. Central-station supplies have gained in sales valume and a number of reports from manufacturers indicate that the past month maintained a level in volume slightly better than

last year. Inquiries are being received in good volume. Numerous additions and some new construction plans are being developed, notably in eastern Massachusetts.

Among heavy equipment lines, turbo-generators are of interest; installments of large units will be carried out in eastern Maine, in connection with a large mill project, and in Cambridge, Mass., where about $180,000 will be expended for increased service requirements for Harvard University. Street lighting in a number of towns is attracting attention and a number of projects are being considered. Merchandising is steady; for the past month a well-known group of central stations recorded a gain in volume over that which was reported for last year.

CONSTRUCTION PROJECTS

Grafton County Electric Light & Power Company, Boston, Mass., is having plans drawn for a hydro-electric power plant at McIndoes, Vt., reported to cost over $250,000. Warren Foundry & Pipe Company, Boston, Mass., has approved plans for a plant at Everett, Mass., to cost $450,000. Edison Electric Illuminating Company, Boston, Mass., plans power substation at Roxbury, to cost more than $100,000. Hartford Electric Light Company, Hartford, Conn., will build an addition to power plant at South Meadows. Cambridge Electric Light Company plans substation and additions worth $476,000, new equipment worth $214,000 and generating equipment totaling $180,000.

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SOUTHEAST

—A SUSTAINED VOLUME *of business is reported in the Southeast, with the outlook for central station and industrial, particularly central station, business in the next 60 days very bright.*

—CONTRACT *was let last week covering the fabrication, delivery and erection of all power-piping requirements for the Atkinson plant at Atlanta, which will involve $75,000 in materials.*

Approximately $18,000 in control and varnished-cambric, lead-covered cable was ordered for this steam plant and bids have been asked for the recording instruments and gages to go into the same plant. Another large central station order was for 120,000 lb. of solid and stranded bare and weatherproof copper, while some smaller orders were for distribution transformers amounting to $4,700 and meters costing $3,065. An aluminum company in Tennessee ordered three synchronous motor-generator sets costing approximately $170,000 and a steel mill in Alabama ordered switching equipment amounting to $13,000. An oil company in Louisiana placed an order for a 700-hp. motor and control equipment costing in the neighborhood of $6,000, while an industrial plant in Tennessee purchased transformers and switchboard equipment amounting to $3,000. On the electrification of a cotton mill in middle Georgia, reported last week, the electrical materials and apparatus required will amount to $50,000, instead of $35,000 as originally reported.

CONSTRUCTION PROJECTS

Bells Light & Water Company, Bells, Tenn., plans extensions in power lines and lighting system to cost over $40,000. Maryville, Tenn., contemplates extensions in ornamental lighting system. Cranford Furniture Company, Ashboro, N. C., plans plant to cost $140,000, all machinery electric operation. Gulf States Steel Company, Birmingham, Ala., plans mill addition to cost $2,000,000. Augusta, Ga., is reported planning a municipal hydro-electric power plant to cost $6,000,000, and has engaged engineers to make report on project.

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MIDDLE WEST

—GENERAL BUSINESS *in the Middle West section continues to show improvement. The volume of business transacted increased at a steady rate during January.*

—WHILE THIS *volume is not as great as a year ago, considerable general improvement in production, consumption and employment is apparent when compared to the preceding month.*

Some of the contributing factors are the increased operation in the steel industry, greater production in the automotive field, steady purchasing of equipment by the railroads, and construction in the electrical industry.

Some of the interesting orders placed this week include 72,000 ft. three-conductor, 370,000-circ.mil, 5-kv., 9,000 ft. four-conductor, 375,000-circ.mil, 5-kv., 6,000 ft. three-conductor, 650,000-circ.-mil, 13-kv., 10,000 ft. one-conductor, No. 0 3-kv. sector, paper and lead insulated cable, 7,000 ft. one-conductor, 2,000,000-circ.mil, 500-volt, 55,000 ft. three-conductor, No. 12 500-volt paper and lead insulated cable, one oil purifier complete with appurtenances and 200,000 gal. transformer oil.

Jobbers' sales are generally satisfactory, although considerably below a corresponding period last year. Inclement weather, together with some industrial inactivity, is largely responsible for lower sales volume. Railroad business, however, continues good and the month of February is expected to show an increase in general business.

CONSTRUCTION PROJECTS

Consumers Power Company, Jackson, Mich., plans construction of two power substations in vicinity of Muskegon, with extensions in transmission lines in that district, reported to cost $3,000,000. Ford Motor Company, Detroit, Mich., plans addition to assembling plant at Norfolk, Va., to cost $1,500,000. Indiana Soldiers' and Sailors' Orphans Home, Knightstown, Ind., will receive bids until February 11 for generators, engines, stokers and other electrical and mechanical equipment for power plant, estimated cost $150,000. Cavalier, N. D., plans municipal electric light and power plant. Sleepy Eye, Minn., will soon take bids for extensions and improvements in municipal electric light and power plant, including equipment. Board of Education, Minneapolis, Minn., plans an equipment repair and supply shop to cost $275,000. Adams, Minn., plans municipal electric light and power plant. Central States Electric Company, Iowa Falls, Iowa, plans addition to power plant. Cedar Falls, Iowa, plans extensions and improvements in municipal electric light and power plant to include steam turbo-generator and other equipment, estimated to cost $120,000.

DELINQUENT ELECTRICAL ACCOUNTS

NUMBER OF ACCOUNTS REPORTED

Division	December 1928	December 1929	Per Cent Increase or Decrease	12 Months 1928	12 Months 1929	Per Cent Increase or Decrease
New York	227	274	+20.7	3,374	3,018	—10.5
Middle & Southern Atlantic	143	161	+12.6	2,202	1,945	—11.7
New England	149	92	—38.3	1,591	1,519	— 4.5
Central	580	643	+10.9	8,764	7,865	—10.3
Total	1,099	1,170	+ 6.5	15,931	14,347	— 9.9

TOTAL AMOUNTS REPORTED

	December 1928	December 1929	Per Cent Increase or Decrease	12 Months 1928	12 Months 1929	Per Cent Increase or Decrease
New York	$50,013	$63,837	+27.6	$509,577	$654,164	+28.3
Middle & Southern Atlantic	19,839	17,925	— 9.6	283,870	260,617	— 8.2
New England	17,706	12,508	—29.4	199,400	211,171	+ 5.9
Central	81,471	90,382	+10.8	1,049,816	954,213	— 9.1
Total	$169,029	$184,652	+ 9.2	$2,042,663	$2,080,165	+ 1.8

New Equipment Available

Outaoor Apparatus Insulators

A COMPLETE ASSORTMENT of outdoor apparatus insulators has been announced by the Westinghouse Electric & Manufacturing Company. Two types make up the complete line, standard

duty outdoor apparatus insulators for ordinary use and heavy-duty outdoor apparatus insulators for applications requiring higher mechanical strength.

These insulators may be mounted either by pin or suspended from above by the cap, or they may be installed in a horizontal position or at angles as the conditions may require.

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A.C. & D.C. Meters on Rectification Principle

SMALL VOLTMETERS AND MILLIAMMETERS, in 2¼ and 3-in. cases, for use on both alternating- and direct-current lines have been announced by the General Electric Company. The meters have molded compound cases and bases, the cases being threaded so as to screw on the base.

These small-size D'Arsonval instruments are equipped with full-wave copper oxide rectifiers mounted within the case. The rectifiers permit the instruments to be used on alternating-current circuits and thus make it possible to provide alternating-current instruments in low voltage and current rating having the high sensitivity, low power consumption and damping of the D'Arsonval element. The voltmeters are available in rating from 2 to 150 volts and the milliammeters from 0.5 to 15 milliamperes. They have wide application in the electrical field.

▼

Single-Pole Element Multiple Switch

A TYPE OF gang-operated multiple switch, known as "BP," in single pole elements, is announced by the Delta-Star Electric Company of Chicago. The pivoted center insulator pushes the blade out of and draws it into the floating contacts by means of an interconnected operating mechanism controlled by a common handle.

The operating mechanism is so arranged that the center insulator unit is in toggle in both full open and closed position. The terminal lugs are of the heavy-duty clamp type. This switch is made for a large range of voltage and ampere capacities.

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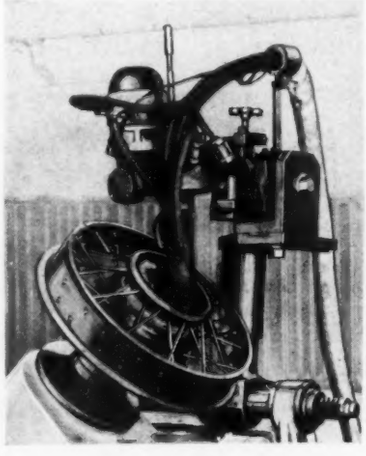
Carbon Arc Welding for Motor Wheels

AN AUTOMATIC MACHINE for the manufacture of wire wheels by the carbon arc welding process has recently



been introduced into the automotive industry by the Lincoln Electric Company, Cleveland, Ohio. The purpose of this machine is to make a lap weld to join the pressed steel parts inside the hub as the wheel turns in a jig. It embodies the features of the "Electronic tornado." No metal filler rod, such as generally is used in automatic welding, is necessary.

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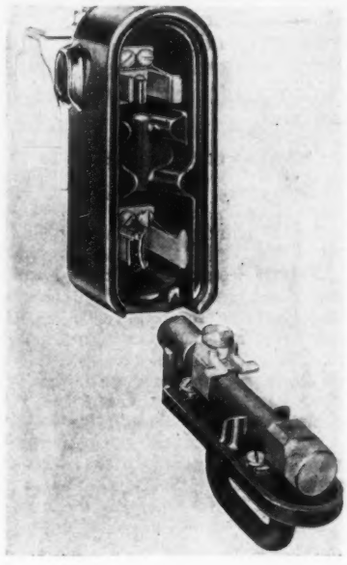
Fuse Cartridge Floats on Door

A FUSE IN WHICH the cartridge floats on the door and the door may be held in the hand while re-fusing is announced



by the Line Material Company, South Milwaukee, Wis. This fuse is rated 2,300/4,000 volts, grounded Y, 30 amp. continuous carrying capacity. The door is of bakelite and removable. The safety feature is especially emphasized. Housing is wet process porcelain.

▼

A NEW RECORDING THERMOMETER capable of charting temperatures from minus 40 to plus 750 deg. F. has been perfected by the Moto Meter Gauge & Equipment Corporation of Long Island City, N. Y. The instrument consists of a dust, fume and moisture-proof housing which incloses the working parts. The element is composed of a bulb, capillary tube and Bourdon tube, filled solidly with a special liquid which has a coefficient of expansion uniform over the entire scale range. The ratio between the pressure of the liquid and the movement of the pen is one to one, so that levers, hair springs, screws, gears and other delicate parts are eliminated. A compensating spring takes up any difference between the bulb and room temperature and automatically resets the pen at the point on the chart corresponding with the bulb temperature.